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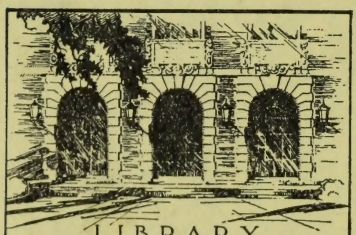

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TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA

(INCORPORATED).

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Anthropological Notes on the Western Coastal Tribes of the Northern Territory of South Australia.

By Herbert Basedow.

[Read October 2, 1906.]

Plates I. to XIX.

The following facts, relative to the characteristics and customs of several native tribes of the Northern Territory, I gathered while acting as Assistant to the Government Geologist, Mr. H. Y. L. Brown, on geological explorations during 1905. The accompanying figures are reproductions of my original field-sketches.

The tribal distribution, and, simultaneously, the extent of tribal territory, of the native population of the north-western coastal districts of the Northern Territory vary directly as the natural resources of the particular locality. The Daly River, as an example, is bordered by fertile flats on either side, with numerous backwaters, or billabongs, that teem with abnormal game. Hence it is that, along the lower reaches of that river, a number of distinct tribes are congregated within a comparatively small area; while west of it, in the absence of any considerable fresh-water stream, two coastal tribes are spread over a great stretch of comparatively poor country.

The *Larrekiya*,* the best known, on account of Port Darwin being included within their domain, occupy a territory extending southwards between the Howard River on the east and the Finniss on the west, a subdivision or clan, the *Märri*, having a local distribution near the mouth of the Blackmore River and forming the southern boundary at about twenty-five miles inland. The *Larrekiya* further separate themselves into coastal and inland groups, the former being called the *Binnimiginda*, the latter the *Gunmajerrumba*.

* This is how the pronunciation appears to me. I am aware that other authors have alluded to the tribe, and adopted slight variations in their spelling. *Vide* Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882 *(Larrakeah)*; Coppinger: Voyage of the "Alert," 1883 *(Larikia)*; Curr: The Australian Race, 1886, vol. i. *(Larrakia* and *Larragea)*; Mackillop: Trans. Roy. Soc., S.A., vol. xvii., 1893 *(Larrikiya)*; Parkhouse: Trans. Roy. Soc., S.A., vol. xix., part 1, 1895, and Austr. Assoc. Adv. Science, vol. vi., 1895 *(Lárraki'a, Larrakiha, Larrikia, Larrakeeha, and Larreekeeyah)*.

They are joined on the west by a coastal tribe, the *Wogait*,* who claim country across the Daly River to about Cape Ford, and on the east by the *Wulna*† tribe. Between the *Wogait* and *Larrekiya*, and passing south of the former to the Daly River mouth, lies the country of a small tribe, the *Sherait*, or "Paperbark natives," closely related to the *Larrekiya*. East of the *Sherait* border the *Gunerakan*. The *Ponga-ponga* tribe lives to the south of the *Wogait*, on the Daly River; and still further south the *Mulluk-Mulluk*,‡ a powerful tribe, holds a large area, which is subdivided and allotted to individual dependent clans, as the *Djiramö*, on the west bank of the river, south-west of Mount Litchfield, and the *Komorrkir*, living on the same bank, south of the *Djiramö*. With a more local distribution, the *Marranunga*, another strong tribe, occupies the country around Hermit Hill.

The *Wogaits* are bordered on the west by the *Berringin*, whose domain extends from Cape Ford to a point about 18½ miles north of Point Pearce, known to them as *Allaitperra*. They are bordered on the south by either a distinct tribe or subdivision of their own, known as the *Kujera*, who were not seen personally. The *Ginmu* are the next on the west, extending, roughly, to the boundary of Western Australia.

Southwards from Port Darwin, along the mining centres, the original tribes have been disarranged by European and Asiatic interference, and it is difficult to secure authentic information concerning their former possessions and rites. One large tribe, called the *Awarrai*,§ has existed south of the *Larrekiya*, extending from Mounts Charles and Gun south to about the latitude of Mount Wells. To the south-east, beyond the Mary River, are the *Agiwallem*, the valley in which Burrundie now stands forming neutral ground.

The tribes east of the Adelaide River were not visited; but through the kindness of Mr. F. E. Benda, Secretary to the Hon. Minister controlling the Northern Territory, I have received the names of tribes of the MacArthur River district, which were collected by the late Cornelius Power, Corporal of Police, stationed at Borroloola. The majority of these names, allowing for slight phonetic variations, have

* Various synonyms for this tribe exist, such as *Waggait*, *Waggite*, *Worgite*, and *Waggote*.

† Sometimes written *Woolner*.

‡ Knut Dahl spells this name *Mollak Mollak:* Trans. Roy. Soc., S.A., vol. xix., 1895, p. 122.

§ *Awárra* of Parkhouse: Trans. Roy. Soc., S.A., vol. xix., 1895; and Austr. Assoc. Adv. Science, vol. vi., 1895.

already been published by Messrs. Spencer and Gillen,* but I, nevertheless, reproduce them here, in confirmation of the statements of these writers. In this list I adhere to the original spelling by Power, which is according to the English pronunciation; while the names in parentheses, immediately following, are those given by Spencer and Gillen in the system of orthography established by the Royal Geographical Society of London.

The *Angoola* tribe (*Anula*) inhabits the McArthur River district, from about Borroloola to the coast, as well as the Pellew Islands at the river mouth.

The *Korraua* (*Karawa*) is a very large tribe, living about the watersheds of the Robinson and Calvert Rivers.

The *Binbinga* (*Binbinga*), a peaceful tribe, occupies the McArthur River district for forty miles south of Borroloola.

The *Godangee* (probably a branch of the *Gnanji*), adjoins the *Binbinga* on the east.

The *Yumpia* (*Umbaia*) lives in country extending south of the *Binbinga*, to the tablelands. Both this tribe and the former are noted for cattle-killing.

The *Alowa* (*Allaua*) territory lies west of the *Binbinga*, in the Limmen River district.

The *Marra* (*Mara*) is a large tribe, occupying the Limmen River, north of the *Allaua*, to the coast, and west of the *Anula*.

The *Willongera* (*Wilingura*) is a small and peaceable tribe, to the south of the *Mara*.

The *Angee* and *Anga* (no doubt branches of the *Nganji*) are small, hostile tribes, living south and west of the *Allaua*, at the head of the Wickham River.

The *Chingalee*† (*Tjingilli*) holds territory to the west, and the *Laytha* to the south, of the *Umbaia*.

The *Goonanderry* is distributed along the Robinson and Calvert Rivers, south of the *Karawa*: and, lastly, the *Wanee* tribe borders the *Goonanderry*, on the south, and extends to the head of the Nicholson River.

Although the dialects of the *Larrekiya*, *Wogait*, and *Sherait* are distinct, it is usual for members of any one tribe to be familiar with the languages of the other two, the *Wogaits*, in addition, having a fair knowledge of that of the *Berringin*. The *Mulluk-Mulluk* dialect is that most generally understood among the various tribes grouped near the

* The Northern Tribes of Central Australia, London, 1904.

† See also A. G. B. Ravenscroft: Trans. Roy. Soc., S.A., vol. xv., 1892, p. 121.

territory of the latter. Short comparative vocabularies of four tribes are appended.

The *Larrekiya* and *Wogait* are, so far as my observation went,* friendly with one another, and tribal intermarriage is not infrequent.

Amongst the *Larrekiya*, given that a man marries the daughter of his mother's sister—the husband of this (his aunt) is *unnya* to him, she being *ngalling* to him, and *halledik* to his *unnya*. The daughter of his *ngalling* then becomes his *halledik*, and he is *ngau* to her. If by the union of *unnya* and *halledik* the offspring is a female, she is *ullmürruk* to the former and *ngalle* to the latter. This *ullmürruk* becomes the property of the corresponding male offspring of his sister, and is to him *nuggangi; ullmürruk* of *unnya* thereby becoming *halledik* of *unnya's nuggangi*. The female offspring of this union is *allitmit* to *unnya*, and may be given to the corresponding offspring of the male child of the *nuggangi's* sister.†

According to the legends of the *Larrekiya* it happened many years ago that a baby boy rose suddenly from the ground out of the burrow of a bandicoot (*Perameles* sp.). He was seen by the people of the *Larrekiya*, who invited him to come to their camp, but he refused. Some time after, when he had become a man, they again met him. Again he was asked to join the *Larrekiya* men in camp, but once more he declined. Thereupon the men became angry, and dragged him to a waterhole, and threw him into it. The stranger immediately sank, and five bubbles of air arose to the surface as he disappeared. The men sat down and watched the water, when suddenly the face of the man reappeared. The *Larrekiya* hurled a spear at him, and he was killed, because he had no father and no mother, but was an accomplice of the evil spirit, who, it is asserted by the old men of the *Wogait*, makes a big fire, from which he takes an infant and places it at night in the womb of a lubra, who must then give birth to the child.

In the ordinary course of events, if a man, when out hunting, kills an animal or collects any other article of diet, he gives it to his gin, who must eat it, believing that the respective object brings about the successful birth of a piccaniny.

---

* *Cf.*, " . . . the *Waggait*, whom both the *Lárraki'a* and *Awárra* detest . . ." T. A. Parkhouse: Austr. Assoc. Adv. Science, vol. vi, 1895, p. 638.

† Parkhouse explains this apparent marriage within the blood-tie, by stating that the relationship is not so close, the line of descent only and not the number of degrees being indicated: Austr. Assoc. Adv. Science, vol. vi., 1895, p. 641.

In other words, conception is not regarded as a direct result of cohabitation. The child, on no account, must partake of the particular food until it has successfully teethed.

At childbirth the navel cord is twisted off. What may be the consequence of this treatment is the fact that abnormal swellings were frequently seen in the region of the navel in grown-up individuals.

During the menses of a woman the man must not receive any food from her, or she from him; otherwise it is believed that a serious illness will result on either side, which no medicine-man could alleviate. If, however, by accident or misunderstanding, food has passed from man to woman, or *vice versa*, the medicine-man may be summoned, who removes the pain by gestures and by pretending to remove an offending body by sucking, eventually shewing a piece of meat covered with blood to the sufferer.

If a medicine-man has a bad case of sickness to deal with, he pulls out a few hairs from his armpit, burns them, and places the ashes in the nostrils of the patient, over which he holds his hands in the shape of a funnel and blows thereon.

When a dugong has been captured by the men, all women are kept at a distance, and not allowed to witness the cutting-up of the spoil; but they may subsequently take part in the feast. If they were present all the flesh would pass from their bodies, and they would become barren.

The aborigines make the statement that when they kill a dugong (which is said to be often done by forcing small rods into its nostrils) it wails and whines pitifully like a human being. The female animal, further, is said to carry her young on her fin like a lubra carries her infant,* and, swimming with the other fin, suckles it. When tired, she changes about from one fin to the other.

According to their traditions, long ago a blackfellow ate a certain berry, when some of the juice squirted into his eyes. The pain was intolerable, and he became blind. In his agony he tossed himself about until he fell, and began to roll down the hill-slope on which he had been sitting. His body continued rolling over and over until he reached the cliffs on the coast, and fell into the sea. The rolling motion continued until he was gradually converted into the form of a dugong.

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* *Cf.* Keppel's remark on the motherly affection of the female dugong: A Visit to the Indian Archipelago, 1853, vol. ii., p. 179.

Funeral Ceremonies.

When a man dies, the corpse is kept for a day, and painted over with ochre. The fat of the deceased is rubbed over the bodies of the mourners, the gins included. In former days the general custom, now only retained by the furthest-out tribes, was to construct a platform of boughs and bark in the forks of trees, upon which the body was left until all the soft parts had been removed by birds of prey.* See pls. v. and vi. A bone† (radius) of the left arm of the deceased is then taken, tied to a necklace, and worn round the neck of a relative, who thereby is supposed to acquire the strength and qualities of the deceased. The remaining bones of the skeleton are wrapped up in paper-bark (*Melaleuca leucodendron*) and buried.

The bodies of old men and old gins are buried in the ground without having been previously placed in a tree.

The interment is carried out by four men, who stand above the grave (which is about 5 feet deep), and hand the corpse to two men down below. The latter place it in a recumbent posture on its right side, with the legs tucked upwards, and the head resting upon the hands. The female mourners gash their scalps with the points of yam-sticks, and scar the backs of one another. See pls. iii. and vii. The men cut their upper arms and thighs transversely with stone knives, or gash their foreheads with the sharp edges of their spear-throwers. Both parties cover their bodies and hair with pipeclay and ashes. Songs of wailing are sung by both males and females, those of the women resembling the sounds expressed by:—

Nge e n'
Hö hö un un.

---

* *Cf.* J. L. Stokes: Discoveries in Australia, 1846, vol. ii., p. 295, *et seq.*, and plate; E. J. Eyre: Journs. Expeditions of Discovery into Central Australia, 1845, vol. ii., p. 345, and plate; H. Keppel: A Visit to the Indian Archipelago, 1853, vol. ii., p. 181, and plate; J. D. Woods: Trans. Phil. Soc., S.A., 1879, p. 84; P. Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 5; Curr: The Australian Race, 1886, vol. i., pp. 255 and 272; W. G. Stretton: Trans. Roy. Soc., S.A., vol. xvii., 1893, p. 237; T. A. Parkhouse: Austr. Assoc. Adv. Science, vol. vi., 1895, p. 643; W. E. Roth: Ethnological Studies among the N.W. Central Queensland Aborigines, Brisbane, 1897, p. 165, pl. xxiii., fig. 406; T. Worsnop: The Prehistoric Arts, Manufactures, Works, Weapons, etc., Adelaide, 1892, p. 66, pl. xxxiv.

† *Cf.* Spencer and Gillen: The Northern Tribes of Central Australia, 1904, cap. xvii. The Port Essington natives are said to have carried all the bones about with them in baskets. Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 6.

The response on part of the men is equivalent to long-drawn:

$$\overline{\text{He}}\text{-e ö, } \overline{\text{He}}\text{-e ö, } \overline{\text{He-e}}\text{ ö;}$$

the *n'* and *un*, above, and the *ö*, below, sounding like sobs. Seeds of the *Cycas media** are collected, and stored in water for three days, when the mourners congregate and feast upon them.

After the body has been interred a sign-post is erected at some distance from the mound upon which the spear-thrower of the deceased is stuck into the ground. It consists of an upright pole.† to the top of which a bundle of grass is fixed; just beneath it is fastened a cross-piece, projecting to unequal lengths on either side, round each end of which is wrapped a bundle of grass; the whole resembling in appearance a scarecrow with outstretched arms. The longer of these horizontal arms has inserted into it a rod which points directly to the site of the grave. Suspended from the end of the opposite arm are feathers or paper-bark, in such a way that they swing in the wind, and so serve to attract the attention of passers-by, who can recognize the spot, and pay their respects to the departed. In the meantime the main camp has removed from the locality.

During the mourning ceremony the spears of the deceased are placed across a frame, consisting of two branches of trees resting in the forks of two pairs of upright stems driven in the ground.

In the *Mulluk-Mulluk*, when a man dies outside his tribal country he is buried immediately. A circular space is cleared for a radius of about eight feet, in the centre of which the deceased is interred. Over this a mound of earth is made, which is covered with sheets of paper-bark, kept in place by three or four flexible wands stuck into the ground at their ends, and passing over the mound transversely to its length. Stones are laid along the border of the grave, and one or two upon the mound. See fig. 1.

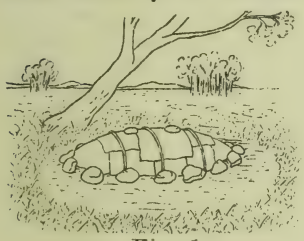

Fig. 1.

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* Foelsche mentions the eating of yams during the mourning ceremony of children: Trans. Roy. Soc., S.A., vol. v., 1882, p. 5.

† Similar, no doubt, to the painted pole described by Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 5.

The corpses of well-nourished children up to the age of two or three years were primarily disposed of by eating them,* but this custom is not at the present day strictly adhered to by the semi-civilized peoples.

Every native believes in his re-incarnation after death in the form of some living being which is always held in respect † by him. This belief, however, did not appear to be general amongst the *Larrekiyas* that were questioned.

Personal Mutilations.

Female infants are subjected to mutilation by removal of two joints of the right forefinger.‡ In the western tribes, *Ginmu*, the finger is cut off with a stone knife. Elsewhere it is amputated at a later age by binding tightly round the joint a ligature made of cobwebs of a spider that lives in the mangroves, the limb withering away gradually. It appears, also, that in certain instances the joints are removed by biting, and in the *Wogait* the amputated segment is buried in an anthill. The operation takes place without ceremony, and does not seem to be strictly adhered to by the latter tribe A singular case came under notice in the *Ginmu* tribe, where a young girl had had the two joints of her finger imperfectly removed, and upon the mutilated stump a horny growth, which resembled a diminutive finger-nail, had grown.

When a child of either sex has reached the age of about six years its nasal septum is perforated. The operation is performed by an old man, who seizes the septum with thumb and forefinger, draws it forward, and pinches a hole through it with the nails. Through the perforation a small, sharpened bone of a kangaroo is inserted, and the hole made larger by gradually expanding it with a peg. During the operation another man holds his hands firmly over the ears of the child, which is thus not supposed to perceive the pain. When the hole is large enough, a single small smooth segment of bamboo is inserted by passing it over the kangaroo bone. The child must sleep upon its back until the wound has healed. The bamboo is replaced from time to time by a larger one, and if, by chance, the rod should become fixed by clotting of blood or otherwise, a strong blade of grass is inserted between the

* *Cf.* Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 5.

† *Cf.* Parkhouse: Austr. Assoc. Adv. Science, vol. vi., 1895, p. 640, second paragraph.

‡ *Cf.* Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 7; Mackillop: Trans. Roy. Soc., S.A., vol. xvii., 1893, p. 257. Dr. W. E. Roth informs me that the practice of mutilating the little finger is still in vogue in Queensland, and in early days was prevalent down the coastline, certainly as far south as Sydney.

rod and edge of the hole, and, being held by either end, drawn round the rod circumferentially to scrape or saw through the adherent parts. The operation takes place without any particular ceremony, and men and women, alike, may be present. The nose-stick is not usually worn except during corrobborees, and when neighbouring tribes are visited.* See pl. ii.

Bamboo nose-stick: *Lar.*, Damörrenelle; *Wog.*, Widjadöl; *Sher.*, Yinnung delluk.

Wooden nose-rod: *Lar.*, Mamalölma; *Wog.*, Barrong nget.

Body Scars.

As a very general rule, the raised cicatrices are less pronounced than in Central Australia, and are, except in certain cases, developed to a less extent in the coastal than the inland tribes. In the *Larrekiya* low cicatrices are favoured; abnormally-developed scars being associated with an early death. Among the *Larrekiya* and *Wogait* it was noted that the chest incisions, particularly in the case of the younger generation, were not treated, as is generally the custom, by the application of ashes into the wound.

The scarring of a *Wogait* boy is for the purpose of preparing him for the rite of initiation. If he can endure the cutting or scarring of his chest with fortitude, and without showing signs of pain, he is ready for the ceremony of circumcision.

In the *Ginmu* tribe the scarring *(ngeri)* of a boy is done at an early age by degrees, commencing on the upper arm, and ending on the chest, with the same object in view as amongst the *Wogaits*, viz., to make him hardy before circumcision. Among members of this tribe were noted one initiated youth with upper-arm scars and two chest incisions, another with four of the latter, a man with two chest and ten abdominal scars (the latter being interrupted centrally), a warrior with twenty-five abdominal and chest scars, and red-ochred bands across either shoulder. A girl about eight or nine years of age was cicatricised in the manner shown in fig. 2. The asymmetrical character of the abdominal scars is possibly related to the age and sex of the child. Two joints of her right index finger had been removed.

Fig. 2.

* Stokes mentions that the Port Darwin blacks "had a piece of bamboo, eighteen inches long, run through the cartilage of the nose." Discoveries in Australia, vol. ii., p. 19.

Another form of self-mutilation which men or women may inflict upon themselves at any time is produced by the application of the heated end of a fire-stick four or five times to the upper arm, and diagonally down the middle of the chest from either side. See pl. ii. This also gives rise to elevated scars.

First Initiation Ceremony of the Larrekiya Youth—The Böllier.

When the *Larrekiya* boy is to be initiated, his body is decorated with bands of white that are made by sticking on to him vegetable down from the seed-pods of a large tree, locally called the silk-cotton tree *(Bombatt malabatrica)*, and feathers. A horseshoe-shaped band is thus formed, passing from ear to ear, down the cheeks, and below the chin; the upper ends of this figure being connected by a horizontal band passing across the nose below the eyes. A similar band extends in front from shoulder to shoulder, above the nipples, and from this, two bands pass downwards over the abdomen and thigh to the knee, where each unites with a circle round the joint. From both shoulders a white line is drawn along the upper arm to the plaited arm-girdles at the elbow; additional bracelets being worn at the wrists.

Round his forehead is tied a band, known as *galambaua*, made of numerous twisted strands of opossum-fur, woven closely together, and coated with pipeclay. See pl. ii. The ends of the strings of this band are tied together at the back of the head by means of human-hair twine. Underneath the *galambaua*, at the centre of the forehead, is inserted a plume of feathers of the Nankeen night-heron *(Nycticorax caledonicus)* or emu, attached to an ironwood stick, the plume being downwards, while from either side of the head a fur-tassel *(Gwiyärum gaulüpmagga)* is hung by string. Identical appendages are fastened to the armlets. A necklace made of segments of grass stems threaded together *(mangulma)* is worn, and a broad belt *(danbidjulu)* of stringybark *(Eucalyptus* sp.), which, by virtue of its coiled form, can be adjusted to a waist of any size. The latter is made secure by tying the outer overlapping end with fur string, which is then wound continuously and spirally round the belt for its whole length and back again, thus producing a lattice-like effect. See pl. ii. The usual human-hair belt *(berelgma)* is tied over this, and from it the pubic tassel *(doi-ira)* is hung.

The boys—several pass through the ordeal at the same time—are separated, and made to sit in a row before the old men, holding their eyes shut with their right hand. The warriors, with the variety of spear afterwards to be described as

wallugirrima poised, stamp their feet in front of the boys uttering harsh cries of *árr-re! árr-re!* and *göra!* On the conclusion of this performance the boys, upon a given signal, look at the men. This finishes the first part of the ceremony.

For the next few months the boys, who are now styled *Böllier*, are kept away from the women and camp. They are led away into the bush by the men, whom they must assist by gathering food, and in other ways. At intervals they are submitted to severe blows between the shoulders by the old men in charge, and given to understand that they must, on peril of death, preserve strict silence as to all that has passed. Upon his return to camp, the *Böllier* usually has additional cicatrices inflicted upon his upper arm and thigh.

The *Larrekiya* does not circumcise, though they say that in early days the rite was practised until, at one ceremony, a subject died from the effects. Their belief is, now, that if anyone of the *Larrekiya* were to be circumcised he would die.* The Melville Island natives, also, do not circumcise.†

The Initiation Ceremony of the Wogait Youth.

At the initiation of a *Wogait*, after his fortitude has been tested by scarring the chest, he is thrown on his back over the legs of four men, who sit close together two and two, facing one another, with their legs alternately spaced, so that the toes of one are next to the buttock of the man opposite; the legs of the four men forming, collectively, a continuous platform. ‡ This stage is shown in fig. 3. A fifth man then sits upon the victim's chest, facing the operator; while another holds his head. The boy is gagged with a bundle of fur, which further serves the purpose of allowing him to bite upon it during his pain; his ears are stuffed, and his hands kept at his sides. The operator, smeared all over with pipe-clay, approaches from behind, and, kneeling upon the boy's thighs, draws the prepuce well forward, and cuts it off with a quartz flake. The wound is

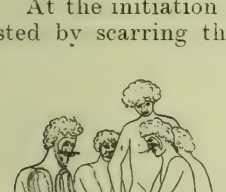

Fig. 3.

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* *Cf.*, "A reason was given for the custom falling into desuetude that the skin became too tender." Parkhouse: Austr. Assoc. Adv. Science, vol. vi., 1895, p. 643.

† *Vide* Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 17.

‡ "In the ceremony of the *Aggrakundi*, a tribe south of the *Ararrai*, eight men lay on the ground, their faces in their folded arms, head and feet alternating, the backs forming a platform. Upon the buttocks the boy was laid. . . ."—Parkhouse, *op. cit.*, p. 645.

covered with paper-bark and ashes,* and the sufferer, who usually faints during the operation, is led away to the bush for about three weeks. Upon his return to camp he shows the operated part first to his mother, and then to the girl who has been selected as his wife; these scar their heads with a pointed yam-stick. The excessive degree of excitement and fear apparently makes the lad practically unconscious to pain, and after the event he is usually quite oblivious to what has happened.

The detached prepuce *(garijet barre)* is held against the bellies of those who have been present at the operation, then placed in a small dilly-bag *(garad)*, and worn round the neck of the operator until the wound has healed, when it is thrown into the fire. The cutting-flake used for the operation is embedded at one end in the wax of wild bees, which is heated and moulded round a bamboo. Into the groove thus produced the stone is thrust, and firmly embedded by squeezing the wax with the hand.

Although the *Larrekiyas* do not circumcise, yet when a performance of this nature is about to take place amongst the *Wogaits*, invitations to be present are sent to the former tribe, and the members of the two hold a joint corrobboree.

The following are some of the chants of this joint corrobboree:—

1. Narraya injala, bannaya injala, bannaiyaka injala bana; injala bannaiyaka injala, bannaya injalö bana.
2. Narraya kaninba, larrambana kanimba, larranbarraya kaninba, larrambana kanimba.
3. Anna yan na na ranga bana na ya ni ba, en kara bana, kara gan dorne, di di di di.

The corresponding accompaniment that is blown into the wooden trumpet or *kanbi* of the *Wogaits*, sounds, in the first chant, like:—

Didnodiddö diduadu didnadiddö diduadu - - - - - - - - - - - - - - didnarib;

in the second:—

Didjuadeldo, didjuadeldo - - - - - - didjnadelrip;

and in the third:—

Tid ja ru du, tid ja ru du, tid ja ru du - - - -

None of the north-western coastal tribes cited practise the rite of sub-incision, but it is well known that the tribes border-

* *Cf.* Knut Dahl: Trans. Roy. Soc. S.A., vol. xix., 1895, p. 122.

ing the Gulf of Carpentaria,* such as the *Anula*, *Mara*, and *Binbinga*, do so† to the same extent as in the Central Australian tribes. The rite was not observed in the tribe at the mouth of the Victoria River.‡

The Initiation Ceremony of the Larrekiya Girl.

Although the girls of the *Larrekiya* and *Wogaits* are given away to men at a very early age, no cohabitation must take place until after the "smoking ceremony" of the girl, which is known as *Männiugu* by the *Larrekiyas*, and *Nitkurrum* by the *Wogaits*.

When the menses have commenced she must undergo the following ceremony, which takes place at night-time, and at some distance from the main camp, though not necessarily out of sight of it. Men do not attend, but may witness the proceedings from the camp at a distance.

Fig. 4.

The girl, being decorated after the fashion of the *Böllier*, is seized from behind by an old gin (under whose care she has been), who places her hands upon the novice's shoulders. See fig. 4. Another woman places her hands upon the shoulders of the old gin in a similar manner, and the same thing repeated by the array of females taking part in the function, one standing behind the other

A chant, a long-drawn, continuous "*Ya, Ya, Ya,*" is commenced; the old gin at this stage, stamping on the ground with her feet, moves forward and pushes the girl in front of her, while all the other women respond similarly, and follow in a line.

This chant suddenly ceases, and is replaced by another sounding like "*Yen da min,*" the old gin stopping at this stage and imparting three smart blows upon the girl's back.

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* *Cf.* W. G. Stretton: Trans. Roy. Soc., S.A., vol. xvii., 1893, p. 232.

† *Cf.* Foelsche: Trans. Roy. Soc., S.A., vol. v., 1882, p. 17. Tribes inhabiting the western coast of the Gulf of Carpentaria, between the Roper and Nicholson Rivers, have a practice of slitting the penis along the urethra; Spencer and Gillen: The Northern Tribes of Central Australia, 1904, p. 133. From the Urabunna in the south, right through the centre of the continent to the western shores of the Gulf of Carpentaria, sub-incision is practised upon the young men.

‡ *Cf.* MacKillop: Trans. Roy. Soc., S.A., vol. xvii, 1893, p. 257.

The stamping motion, and the "*Ya, Ya, Ya,*" are commenced afresh, to be again changed to "*Yen da min*" and three blows on the girl's back. This procedure is kept up for the greater part of the night.

At the first glimpse of day the second item in the programme is started; it consists of the washing of the girl in the sea.* She is led to the water, and all taking part in the ceremony wade out with her to some depth. On gaining deeper water the whole party go through a grotesque "goose-waddle-like" dance, flapping their arms, which are kept bent at the elbows, alternately at either side, and, in so doing, splashing the water up over their bodies with the production of a peculiar hollow-sounding noise.

Another refrain is now chanted: "*A-lö-lö-lö,*" and when the last syllable has sounded all the bathers dip under the surface of the water, the same thing being repeated many times.

The third part of the programme, following directly upon the washing, is the smoking of the young gin. A fire is made on shore, and when a good blaze has been secured, a large heap of green grass and leaves, previously steeped in water, is piled upon it. On this the old gin seats herself, and on her lap, with legs astride, the young gin. More grass and leaves are piled on the heap, and the vast volumes of smoke that are generated completely hide both women from view. The object is that the smoke shall thoroughly play upon the genitalia of the girl, the process being facilitated by the manipulation of the old gin upon whose lap she is seated. This event finished, the principal ceremony of initiation is concluded, and the novice is led into the bush by the old women, returning with them to camp the same day. Through the period the girl's diet is restricted during the pleasure of the old gin. She is not allowed to eat snake, dugong, monitor *(Varanus sp.)*, turtle, etc., but may have crab.

No cohabitation takes place between the young gin and her husband for about four months after her initiation, but at each recurrence of the menses she cleanses herself with water, without repetition of any ceremony. The man must not receive food from her during these periods, as otherwise he would become subject to severe pains in the stomach, and become readily susceptible to injury. If, for instance, in their excursions hostile blacks were encountered, he would

* It is interesting to note a similarity of these proceedings recorded from the western islands of North Australia: Reports Cambridge Anthropological Expedition, Torres Straits, vol. v., 1904, chap. vi., pp. 201 *et seq.*

be certain to become the victim of any spear thrown by them.

A subsequent secret corrobboree of initiation, about which very little is known, takes place several years later, and corresponds to the *Mollinya* ceremony of the men, which is described below.

In conformity with the absence of sub-incision among these western tribes, the corresponding mutilation of the female is not in vogue.

Second Initiation Ceremony of the Larrekiya Youth—The Mollinya.

Some years after the *Böllier* ceremony comes the *Mollinya*, after which the subject becomes entitled to join in the discussions of the old men. On this occasion the youth is under the care of an old man, and is decorated in a somewhat similar way as in the first ceremony. The broad, white forehead band, or *galambaua*, marked transversely with four stripes of red ochre, and the similar appendages from head, elbow, and waist are worn. He carries, in addition, a plume of cockatoo feathers, known as *biamörre*, in his hair. See pl. ii. The performance—at which only the old men (all initiated *Mollinyas)* are present, while no mention of the ceremony is made to the women—commences soon after sundown, and ends before midnight. The youth, in the presence of his guardian, must remain silent, and with downcast eyes. A wailing chant is sung in low, broken accents: "*Makolär manga, makolär, ä är, makläг, immanga.*" No beating of sticks or hands accompanies the tune, and no definite ceremonial dance follows.

After the *Mollinya* ceremony, cicatrices may be added on either side of the abdomen, each cut extending to under halfway across the front.

During the time between the *Böllier* and *Mollinya* rites, bustard, flying-fox, and yam are forbidden as articles of diet, but at the latter corrobboree he is invited by the old men to eat. The man believes that even if he ate one of these foods secretly during the forbidden period, the medicine-man would, on his returning to camp, at once detect it in his stomach. And having thus disobeyed, the medicine-man would have perfect right to run a spear through him, or compel him to eat certain things, from the effects of which he would die. But, although he must not eat the forbidden foods, the youth is not forbidden to hunt them, so long as he delivers up the spoil to the old men. These rules are strictly observed, and, whenever privileged members have eaten flying-fox, the bones are carefully collected and burn-

ed, to make certain that no boys could possibly have access to them.

Corrobborees and Friendly Meetings.

At ordinary corrobborees, other than those connected with the initiation ceremonies, a tall, conical headgear is made with grass, bound round with fur-string, the outside being smeared with pipeclay, to which vegetable-down is made to adhere with viscid sap. This conical structure fits over the hair, which is drawn up into a point and smeared with pipeclay; over it the grass-binding fits like a helmet. A small, pointed stick, or bone, carrying a plume of emu feathers, is inserted into the top, and the whole of the wearer's face, with the exception of the eyelids and lips, is covered with vegetable-down. The helmet is known under the following names in the different tribes:—

Larrekiya—*medlemö.*
Wogait—*ärak.*
Sherait—*wennu.*
Berringin—*nurö.*

The plume at the apex as *gurrumberring, murun, mokulling,* and *ngodeji,* respectively.

At various friendly gatherings of groups and tribes, chants imitative of other events, sounds, and objects form a prominent feature. Of these a few typical cases will be mentioned. A corrobboree of the wailing of women is one of the most popular amongst the *Larrekiya* and *Wogaits.* It runs:—

Arada kadji mara uda kayan yan: arada kadji mara uda kayan mölle ulpululu mölle, jangaji karra kanjin mada da nga la ulmin ja jandadbi karra kun kun mukale la enbulukdi bana mölle mara kanjinmada da buluk di bölle arada kadji balla.

Lö—e lö lö—e lö—ö lö—ö la Kanjin mada danö wüdningi juan madji karra kunkul mukana mölle enbuluk di bana mölle kanjin mada.

In the above, the line commencing with *lö—e* is sung in a plaintive manner, and is strongly suggestive of the wailing of women at a mourning ceremony, which, indeed, it is intended to represent. As a marked contrast to these seemingly solemn proceedings, the termination is one of merriment and laughter, in which there are many interjections and criticisms as to the imitative skill of one another in the production of effeminate sounds.

An accompaniment is performed by one member on the wooden trumpet,* into which he makes droning sounds that

* See description p. 48 and fig. 63.

may be represented by the syllables, "*Tib bu, tib bu, tib bu a.*" Other performers beat time with their "music-sticks," one long beat being followed by three short taps in quick succession.

In the corrobboree of the frog the following unusually pleasing chant is frequently repeated*:—

Iwoggiama wogien, woggiamana wogien, immangana jellerrima wogien. Imbaka kwuerakwa wogien. Imbelluoluodö wogien.

Yi kwa e kwa, yi kwa e kwa. I wogien. Immangana jellerrima wogien. Imbak kwuerakwa wogien. Imbalualuodö wogien.

Up to the second repetition of "*wogien*" the syllables are uttered with subdued voices, then all members join in heartily. The verse is sung and immediately repeated, with the omission of the initial *Iwoggiama wogien* and the final *wogien*, the voices, moreover, subsiding to almost inaudible softness at the finish.

The "*Yi kwa e kwa*" is sung in imitation of the croaking of a frog, the following "*I wogien*" being extended to five syllables by reduplication of the final syllable.

The accompaniment on the trumpet is "*Tip bu, tip bu, tip bu, tip paū ā, tip paū ā, tip paū ā,*" the last of which sounds something like a "Hoop la!" Music-sticks are used by all, the taps being equally spaced and of uniform strength.

Corrobboree of the arrival of a boat:—

Ima di mana, ima di mana, ima di mana, ima di mana nga kara ra ungöni di ma di.

Corrobboree of the visit to a strange tribe or country:—

Ana ni lai, ni lai; ana li lai, ni lai laie ö kondön linmai endo; di-di, di-di, di-di, di-di, di-di, dia.

The latter chant is accompanied on the "trumpet" with "*Tidjnaror tebor,*" *ad infinitum.* It is succeeded for some considerable time by the clinking of the musical sticks alone.

To become gifted with a sonorous voice is one of the ambitions of native youth. The large *Cicadæ* are admired for their vocal powers and endurance in song. They are, at times, caught and sucked, in the hope that similar virtues may in this way be acquired.

When a man who has been absent on a mission returns to his camp, or arrives at that of a friendly group, he sits isolated from the men for some time, everyone present main-

* *Cf.* Report Government Geologist: Parl. Paper No. 55, Adelaide, 1906 (Journal by L. C. E. Gee, p. 23).

taining strict silence. Eventually the most influential member begins conversation in a low voice, in which other members join one by one. The event culminates in singing and dancing.

Fig. 5.

Fig. 6.

Often the visitor displays, for the information of his friends, the emblem of his mission, or person, painted in pipeclay and ochre upon his chest. If, for instance, he has been about on a turtle-hunting expedition, he returns ornamented with a large design representing a turtle. A striking difference of design is made in distinguishing between a fresh-water (fig. 6) and a salt-water turtle (fig. 5). The annexed figures are *facsimiles* of native sketches.

Superstitious Belief in a Nocturnal Monster.—All the tribes encountered believe in the existence of a creature that roams about, principally at nighttime, and is the terror of the blacks, stealing upon them in their sleep and squeezing their ribs from behind. The term "devil-devil" has been generally assigned to this being by the whites, and has become of common use among the semi-civilized tribes. Among themselves, they speak of it as "*Birrawulidda*" in the *Larrekiya*, "*Winmallon*" in the *Wogait*, "*Barang*" in the *Sherait*, and "*Ngauit*" in the *Berringin*. The "devil-devil" is supposed to possess no nose, two blanks for eyes, and two additional, powerful visual organs at the back of the neck, by means of which he can see a very great distance. When he makes a corrobboree with his companions, he is supposed to use his shinbone as a wooden trumpet, which, after the ceremony, he replaces in its proper place. At daytime he usually camps in holes, or caves, and his tracks are often found by the blacks, who, when they imagine he is near, become stupified, as though intoxicated. When a man has been visited by the evil being, and has had his ribs squeezed, the medicine-man is summoned. The latter ties a stick along the sufferer's back, and requests him to remain lying on the ground until the pain has passed away.

Some of the powerful old men of the tribes profess to have stood face to face with the spirit, away from camp, and to have asked him his name, whereupon he replied, "Me devil-devil," and disappeared.

When a blackfellow has been visited, imaginatively, during the night by the spirit, he does not inform his camp mates of it until the morning. At times the magic influence exerted by the monster over the blacks has the effect that they

fall into a stupor, during which they cannot recognize men of their own clan; and, if such a one were to endeavour to enter the camp of a man in that condition, the latter would threaten to kill even his father, unless awakened from his fit.

Meeting Strangers.—The approach of a tribe to a party of strangers, such as white men, is made in a definite and formal manner, that is also in practice in Central Australia, and appears generally adopted throughout the continent.* One or two of the most influential old men draw near to the strangers, and, in so doing, push before them a defenceless child, upon whose shoulders both men place a hand, as though guarding their bodies behind the exposed figure of an innocent.

Wilson, in 1835, wrote† that Captain Barker used every endeavour to induce the natives to come into the camp at Raffles Bay, but without success, until a little child, belonging to one of the soldiers, went and led in the chief, who was evidently under great alarm, by the hand.

While out on a flying trip in the Tomkinson Ranges, in Central Australia, our party came unexpectedly upon three women, who were busily engaged in cooking a snake, and had not heard the approaching camels. On seeing them in close proximity, two gins immediately fled. The third, with an expression of most pitiable terror in her face, seized her breasts, one with each hand, and forcibly squirted her milk in the direction of the white men.

Asking later the meaning of this strange act, we found that she wished thereby to demonstrate that she was the mother of an infant, in the hope that the white men would not, under such circumstances, do her any harm.

As an important geographical extension, I add that Dr. Roth and Mr. Chas. Hedley have informed me that when they traversed Mornington Island, in the Gulf of Carpentaria, they also came suddenly on a camp. All natives fled, except some helpless pregnant women, who immediately began to squirt milk from their breasts, as I have described. It, too, was evidently an appeal for mercy, and an advertisement of their condition. Apparently, therefore, the custom is widespread.

Hunting.

When hunting, the ochred bodies of the persons act as a protective colouration. The "black boys" employed by bushmen well know the value of the inconspicuous colour

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* *Cf.* T. L. Mitchell: Three Expeditions into the Interior of Eastern Australia, vol. i., pl. xii., p. 194.

† Narrative of a Voyage Round the World, 1835, p. 74.

of their skin when trying to creep within range of game, and they always take the precaution to remove any articles of civilized clothing. The effect is increased by smearing their bodies with the mud of the adjoining country.

The assimilation of the colour of their natural skin to that of "rust-coloured" boulders of granite and other rock is marked, not only in these tribes, but throughout the continent. At Opparinna Spring, in the Musgrave Ranges, one day, had it not been for the alertness of my camel, I should have ridden over the huddled figure of a girl who was hiding from her mates among the numerous rocks, which she endeavoured to resemble by assuming the recumbent position and tucking her head and arms between her knees. The colour and form of her back corresponded so nearly with those of the rocks, that it required more than a casual inspection to recognize a living human figure.

A hunter often awaits his prey in ambush in a waterhole by concealing every part of his body under water, except his head, and, when occasion requires, with nothing but his nose visible above the water. When pursued by foes, he seeks refuge in a similar manner, and in that case takes every care that his breathing does not betray his presence by causing a ripple upon the surface of the water. After the Daly River massacre* the few natives that escaped the rifle-bullets of the avenging whites saved their lives in this manner.

The kangaroo is hunted with the spears, known as *malligirrima* and *dawingwa*. Four or five men post themselves in concealment along a well-known and frequented pad that is utilized by the game on its way to a waterhole, or cover. A large party, including men, women, and children, disperse in the direction where kangaroos are known to be grazing. On drawing near to the animals, all the beaters begin to sing and shout, "*Yē-wo o-ho, yē-wo-o-ho,*" as they dart along through the bush, and continue until a kangaroo is sighted, which is immediately pursued with excited cries of "*Yakäu, yakäu.*" On hearing this shout, the men in ambush become alert, and as the prey leaps by, along the pad, the nearest of them instantly rises to hurl his spear.

If he is successful in his aim he raises a loud and shrill shout of "*Käu,*" as a signal to the driving party, who then assemble at the spot.

A native considers that the most effective part in which to wound a kangaroo is in the hind leg, particularly if the bone should be broken. If struck in the upper part of the

* See Report Government Geologist: Parl. Paper, No. 55, Adelaide, 1906.

body the animal travels for some distance, and requires tracking to secure it.

The large frugivorous bats *(Pteropus gouldi)*, known as flying-foxes, which are nocturnal in habit, are fond of congregating during the daytime in very large numbers in the foliage of bamboos and mangroves, where they hang, head downwards, until dusk. It is an easy matter for the blacks to approach them, and fell a sufficient number with sticks and stones to make a feast. The animals that fall stunned to the ground are gathered and bitten, one by one, in the neck and rump, by the hunters—in the former spot to kill, in the latter as a preliminary test of condition. The restriction of this diet from the uninitiated has already been mentioned.

Emus are most readily killed by climbing into the branches of a tree, the fallen seeds of which are known to be eaten by the birds. The blackfellow ascends the tree in the early hours of morning, and awaits his chance, keeping perfectly silent and motionless when an emu draws near. A special, heavy spear, of the *malligirrima* type, known as *nimmerrima*, is held in readiness. If the bird comes to a spot immediately below the concealed native, the weapon is thrown (without a spear-thrower) in the manner depicted in fig. 7; if, however, it is at some distance off, the spear is held in a slightly different manner, as is shown in fig. 8.

Fig. 7.

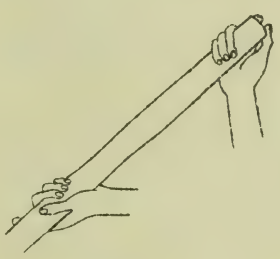

Fig. 8.

Large flocks of wild semipalmated geese *(Anseranus melanoleuca)* visit the same localities periodically. The blacks have got to know these localities well, and, during the absence of the birds, make an excavation in the ground, and cover it over with twigs, paper-bark, grass, and soil, leaving only one or two small lookouts open. A couple of natives sit in this hole and await the return of the geese. As soon as a head or leg of a goose comes near to the window, it is seized, drawn below, and its neck wrung. In this way many birds may be secured.

After the first appearance of wild geese at the billabongs and lagoons, the women are not allowed to eat of their meat, believing that if they did so the geese would become lean and bony.* Only after the geese have settled for some considerable time in a certain locality are the gins allowed to partake of this food.

The clever imitation of the cries and calls of these birds, a "*ngá ngáng, ngáng-ngáng-ngáng*" induces large numbers of them to be attracted, at dusk, close to the native, who sits in the branches of a tree, and kills the birds with a stick.

These birds can also be lured, by imitating their call, so close to a native seated motionless in high grass that they can be actually grasped by hand.

The note of the whistling duck (*Dendrocygna eytoni*) is also accurately reproduced, by which flocks of them are attracted and killed with a throwing-stick while hovering round the hiding native. Cockatoos, plovers, and other birds are secured in a similar manner.

The presence or whereabouts of crocodiles (*C. porosus*) and dugongs (*Halicore australis*) in water is traced by the swirl and bubbles produced at the surface, and they are speared from a raft or canoe. A dugong is further detected, when feeding below the surface of the sea, by noting the nibbled portions of seaweed rising to the top. Young crocodiles are caught by hand from the bows of a canoe by cautiously drifting upon them as they float in the water.

The natives explain that the teeth of young crocodiles have not hardened sufficiently to do harm, and they even show no fear while swimming about among full-grown individuals.

When a dugong has been killed by being speared from a canoe, the craft is submerged, the occupants swimming alongside and pulling it under the floating carcass of the prey. The water is then bailed out of the canoe, which rises, and lifts the dugong with it, and it is rowed ashore by the hunters.

A turtle is caught by diving after it from a canoe, with a line, and passing a slipknot round one of its paddles, when it is hauled to the surface. If the head of a swimming turtle be seized and held upwards towards the surface of the water it is helpless so far as escape by diving is concerned. Harpooning is also widely practised.

In the folklore of the *Larrekiyas* the fresh-water turtle, known to them as *pennimell*, once lived in the sea; and the

* *Cf.* Stretton's remarks on the eating of flying fox: Trans. Roy. Soc., S.A., vol. xvii., 1893, p. 240.

salt-water species, which they call *dorl-lurre*, in fresh water. One day the long-necked *pennimell* came out of the sea, and said to the then fresh-water *dorl-lurre*, "I can find nothing to eat," to which the latter replied to the same effect. A mutual exchange of territory was therefore agreed upon.

Fishing.

Fishing is one of the principal occupations of these coastal tribes, consequently a variety of methods are in use.

Fish are caught by building barriers* of rock across the entrance to small, shallow bays, which, upon recession of the tide, retain at times large numbers of fish, either high and dry, or in very shallow water. Such structures were noted particularly at Cape Ford and Hyland's Bay, in *Berringin* territory. As a modification of this device, barriers of paper-bark and branches, stayed by vertical rods driven into the sand at short distances apart, are erected across the beds of temporarily-flowing waters, such as the McKinlay and Cullen Rivers. After the passing of flood-waters many fish are retained by the obstruction. It may be mentioned that these fish, which are often of very considerable size, live, during the dry seasons, in the permanent waterholes that occur at intervals along the river courses.

Those fish which are left behind in comparatively shallow holes are captured by a party of natives, who enter the pool at one end and, as they move in a body towards the other end, with much splashing, shouting, and beating with sticks, drive the fish to the shallow water there. Then, with a sudden rush, and before the fish can regain deeper water, many are retained by mud and captured. See pl. viii.

When the water becomes very turbid by this agitation the barramundi *(Ceratodus)* has the peculiar habit of rising to the surface and throwing itself upon the mud banks, to fall a prey to the native. This turbidity is very apparent after a mob of wild cattle have visited a comparatively small water, when these fish can be gathered in large numbers, or else they fall victims to numerous birds of prey.

In the holes left along the seashore they are caught in a slightly different manner. Several natives sit at one end in shallow water, with their legs bent at the knee, spread apart, and feet drawn in under their buttocks. Another party walk towards them from the opposite side, driving the fish before them in the manner described. The fish endeavour to pass or hide underneath the limbs of the sitting

* *Cf.* W. E. Roth: Ethnological Studies, p. 95, pl. xi., fig. 224; and W. G. Stretton: Trans. Roy. Soc., S.A., vol. xvii., 1893, p. 241.

party, but as soon as one comes in touch with the naked body it is cleverly caught by the native's hands, killed by crushing its head between his teeth, and thrown on to dry land. This method was observed among the *Ginmus*.

When sawfish (*Pristis* sp.) are seen in shallow water off the beach, the natives cleverly seize them by the tail with their hands, and before any harm can be done hurl them high on to shore.

Fishing-nets are made by first forming a ring, about five feet in diameter, from the long shoots of *Spinifex* growing in the sand-dunes on the coast. Two pairs of these shoots are twisted, two-and-two, one about the other, and bent into semi-circular shape, the two ends of each twisted pair being tied together with vegetable string, thus completing the circle (as shown in fig. 9). Round the inside of this hoop is tied a circular net, which is made of long vegetable strands, usually derived from hybiscus bark. The knitting of this meshwork is done by hand, without the aid of tools. The successive stages in the manufacture of the net are most readily explained diagrammatically, and are given in the following figures, the knitting in the last case being repeated indefinitely from mesh to mesh, until the required dimensions have been attained.

Fig. 9.

Fig. 10.

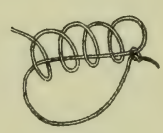

Fig. 11.

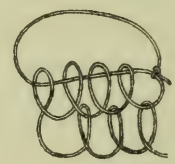

Fig. 12.

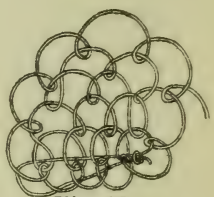

Fig. 13.

When this net is employed for fishing, two natives, usually females, seize a side of the rim each with one hand, wade out to a suitable depth, pulling the net along between them, its mouth being inclined at an angle so that the lower side projects beyond the upper. See fig. 14. The natives all the while beat the water on either side to drive the fish into the net, the mouth of which, as soon as one is noticed to have entered, is quickly turned up into a horizontal position, and the fish bagged.*

* *Cf.* W. E. Roth: Ethnological Studies, p. 9

Fig. 14.

Two types of fish-hooks are employed, but their use is becoming more or less obsolete from the use of metal hooks obtained by barter. The simpler form is cut from a flat bone of kangaroo, or from pearl shell, and has a slight notch at its upper end to permit of the string being securely tied to it.

In the other pattern two bones are tied at an acute angle with vegetable string secured with resin or wax. See fig. 15. The shorter piece is previously pointed at its free end; the longer possesses an enlargement at one extremity, to which the line is fastened, usually as follows:—The string is folded at one end into a loop, through which the bone is passed (see fig. 16), and it is kept in place by binding another string, as shown in fig. 17. The line is attached to a long rod.

Fig. 15.

Fig. 16.

Fig. 17.

The common form of fish-spear measures from ten to eleven feet in length, and consists of a single shaft of bamboo, tapered slightly at its thicker end, into which three slender, pointed rods of ironwood *(Erythrophlaeum laboucheri)* (or, in the semi-civilized tribes, fencing-wire) are inserted, the attachment being tightly bound round with string. Large fresh- and salt-water fish are speared with this weapon, including the barramundi *(Ceratodus)* and stingray *(Trygon* sp.). No spear-thrower is employed, the spear being held poised until the prey comes within close range.

As a convenience in carrying large fish some distance to camp, special carriers are constructed by bending five or six dry reeds into loops, and binding the free ends together circumferentially into the form of a handle. The fish is inserted lengthwise into the loops, which are spread apart to receive it. See fig. 18. Shell-fish and crustaceans form daily meals.

Fig. 18.

Fig. 19.

An ingenious device is resorted to for collecting the honey of wild bees from inaccessible fissures in rocks and hollow tree-trunks. A long, thin rod is chosen, and to one of its ends a tassel of vegetable-strands is tied. See fig. 19. Holding the stick at the opposite end, it is inserted into the cleft

or hollow containing the honeycomb, and worked about in it until an appreciable amount of honey has been absorbed by the fibres, when it is withdrawn and the honey eaten, after which the process may be repeated.

Wilson observed* a native of Raffles Bay squeeze into a basin of water honey out of a meshy, fibrous bundle, formed from the inner bark of young trees, then dip the bundle into the water and suck it. No doubt this bundle of fibres was a modification of the form I have just described, and is known as *galmarrua* to the *Larrekiyas*. It was observed on the Victoria River.

When about to burn down tracts of dry grass and reeds to obtain snakes, lizards, and other small game, the men cut a stick from a tree, with a branch at one end cut short so as to form a hook. Into this hook they wedge a little straw and set fire to it; then, holding the burning end to the dry grass, they run along, pulling the stick after them, the hook being held so that it continually gathers fresh fuel as he proceeds.

Cooking of Game.

The legs of an animal to be cooked are broken and tied together in pairs with hybiscus fibre. The carcass is opened at the side to remove the entrails, and an incision made in the anus to clear it. In the case of a kangaroo, the tail is cut off and cooked separately in ashes. When thus prepared, the carcass, the skin of which is not removed, is placed in an oven constructed as follows:—A fire is burnt over a shallow excavation in sand, and upon the red-hot coals are placed lumps of ant-hill earth to be heated. On them the animal is laid, covered first with paper-bark, then with sand, when it is allowed to cook.†

Fire-Making.

When by accident, such as a sudden tropical deluge, the "fire-stick" becomes extinguished, a fresh flame is kindled by the ordinary frictional process of twirling a rod of dry wood between the palms, with its lower, slightly-pointed end against another piece of wood held to the ground with the feet, the operator being in a seated position. See fig. 20. A little

* Narrative of a Voyage Round the World, 1835, p 99. See also, Keppel: A Visit to the Indian Archipelago, 1853, vol. ii., p. 168.

† A similar method is reported to have been used by the extinct Adelaide tribe. J. P. Gell: Tasmanian Journ. National Science, etc., 1841; reprinted in pamphlet form.

Fig. 20.

powdered material is usually strewn upon the hole in the basal piece of wood. Seeing that this method of producing fire depends upon friction, I was surprised to notice a curious practice amongst the *Larrekiyas*. When, with the twirling stick, the operator had bored out the depression in the horizontal piece, he squeezed the tip and sides of his nose with the finger and thumb, by which means a quantity of greasy matter was expressed from the sebaceous glands. This he scraped together under the nails of his index and middle fingers, and placed the mass upon the ankle of his left leg. Then, after resuming the rotating movements, so soon as the end began to smoke, he touched this against the greasy lump on the ankle, and continued the twirling.

The "sawing process,"* in which the edge of a flat piece of wood is worked by hand backwards and forwards along a groove, transversely to the length of a split piece, in the cleft of which easily ignited material is packed, is also in practice. See pl. x., fig. 1. A peg passing through the cleft pins the basal part to the ground at one end, while the other is held

* See W. E. Roth: Ethnological Studies, p. 105, pl. xii., fig. 245. H. Basedow: Trans. Roy. Soc., S.A., vol. xxviii., 1904, p. 27.

by the operator's foot. The method is very apparent in pl. x., fig. 2, the original of which was given to me by Mr. W. Holtze.

Smoking.

The habit of smoking in these districts, as elsewhere in Australia, has become a passion among the tribes that come into contact, directly or indirectly, with Europeans and Asiatics. When the original supply of tobacco has run out the pipe of one of a group of men is crushed between two stones, and the powder and ashes thus obtained smoked in other pipes. This is repeated down to the last pipe, when it, too, is crushed, and the powder rolled up in dry palm-leaf and smoked like a cigarette.

They have also invented a pipe of their own by breaking off the protoconc of *Turritella cerea*, and filling tobacco into the mouth of the last body-whorl of the shell. The smoke is then inhaled by suction through the convolutions of the shell.

Opium pipes are made out of empty bottles. Having secured a bottle, a native will patiently tap round a certain spot with a pointed implement until he has drilled a small hole through its side. A little opium (usually the third-hand remnants from the pipe of a Chinaman) is placed beside the orifice, ignited, and the smoke drawn into the mouth through the neck of the bottle.

Habitations.

As in Central Australia, habitations are only used under extreme climatic conditions.

The usual plan is to construct a dome-like framework or skeleton of flexible branches as depicted in the sketch (fig. 21), the joints at each intersection being made secure with strands of hybiscus bark. This structure* is covered with paper-bark and grass, leaving the one side open for access. See pl. ix. The floor of the interior, too, is carpeted with the same material, with the exception of a small space left for the fire. The structure measures 5 ft. by 5 ft. by 4 ft. high, and is called

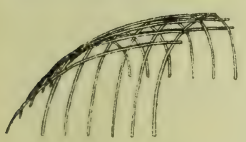

Fig. 21.

* Stokes found similar structures at Cape Hotham, and also at King's Sound: *Vide* Discoveries in Australia, 1846, vol. i., p. 406. Wickham observed huts on Depuch Island, off the north-west coast of Australia, which "were constructed by fixing boughs and twigs in the ground in a circular form, and joining the smaller ends overhead in the form of a beehive": Journ. Roy. Geogr. Soc., London, vol. xii., 1842. See also W. E. Roth: Ethnological Studies, pp. 105 to 107; pl. xii.

albirrekpin by *Larrekiyas*, *bijijilkminit* by *Wogaits*, and *enduk* by *Sheraits*.

In camping-places where mosquitoes are very troublesome the dome is completed by bending the rods down to earth on all sides, and covering the whole surface with bark. Four small openings are left along the base to serve as doors, and a hole made in the top to allow passage of the smoke that is accumulated in the hut for the purpose of keeping out the insects.

Provisional shelters against rain are made by cutting a big sheet of bark from the stringy-bark. To do this the bark is chopped through circumferentially in two places about seven or eight feet apart, and slit longitudinally between the two incisions, after which it is easily removed by leverage. See fig. 22.* The sheet is folded transversely along its centre, and stood on sand in tent-like fashion.

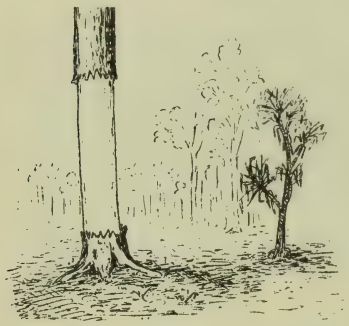

Fig. 22.

Sun-shades are formed by erecting two vertically-forked poles, in the forks of which a horizontal rod is placed. Against the latter, green branches are piled at an incline of about 45 degrees, and the fires lit beneath.

As a variety may be mentioned that found by Stokes† north of Roebuck Bay, and described as a slight, rudely-thatched covering, placed on four upright poles, between three and four feet high.

Stokes writes of natives covering their naked bodies with sand for warmth. A more usual method is to lie upon, and cover themselves with, paper-bark. I have, however, noticed them cover their naked forms with sand as a protection against the attacks of mosquitoes.

Weapons and Implements.

The spears that were observed in use by the North-western coastal tribes will be considered under the scheme

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* *Cf.* R. Brough Smyth: Aborigines of Victoria, 1878, vol. i., fig. 239, p. 409.

† Discoveries in Australia, 1846, vol. i., p. 101, figured.

of classfication of main types of Australian spears, as described by Spencer and Gillen.*

Type (4).—Single-pronged, multi-barbed spears, with the barbs on one side only. The shaft of heavy or light wood:

This is one of the most common types, and usually has the shaft of light wood. See fig. 23. The variations in length

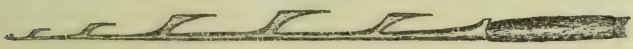

Fig. 23.

of the barbs are marked; the longer they are the less effective is the weapon for hunting purposes, but the more prized as an article of show on special occasions. They measure from a fraction of an inch to several inches, while the length of the spear is from ten to eleven feet, of which the barbed head occupies about two feet.

The shaft is almost invariably made of bamboo, the head being of heavy dark wood, the latter being inserted into the cavity of the thicker end of the slightly-tapering rod up to a small shoulder cut into the head as a short, blunt barb. A firm attachment is effected with beeswax. At the opposite end a small hole is left by cutting the reed a short distance beyond a septum. Sometimes this end is coated with a thin layer of beeswax, and wound round with vegetable fibre or fur-string. In the *Wogait* and *Berringin* the hole is lined on the inside with paper-bark, which is further firmly pressed down into it. This acts as a cushion, saving the point of the spear-thrower from wear. The *Larrekiya* do not take this precaution, but, on the other hand, make the points of their spear-throwers blunt; the former two tribes using a sharp one.

The spears are covered with red-ochre, and during special ceremonies are ornamented with white and yellow patterns.

Type 5.—Single-pronged, multi-barbed spears, with shaft of light wood or reed. The barbs are arranged along two or more sides of the head.

Spencer and Gillen, in describing a form of this type, state that it has evidently been derived from an original form with a long, simple-pointed head. This evolution is apparent

* The Northern Tribes of Central Australia, 1904, pp. 671 *et seq.* *Cf.* also the types described by Etheridge, from the Alligator River tribe: Macleay Mem. Vol., Linn. Soc., N.S.W., 1893, pp. 229-235.

in the following figured specimen (fig. 24) which may be the next stage to an unbarbed spear, with separate head, as defined by the above authors in type 3.

Type 6.—Multi-pronged, multi-barbed spear, with shaft of light wood or reed.

Fig. 24.

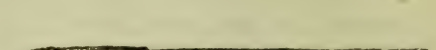

Fig. 25.

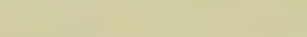

Fig. 26.

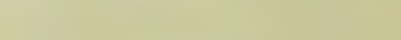

Fig. 27.

A spear eleven feet in length, with three equally-cut barbed prongs of ironwood attached to a reed shaft with resin and paper-bark.* The barbs are comparatively small, each prong containing from eight to eleven. See fig. 25.

An allied weapon is used by the *Larrekiya* and Port Essington natives, but it possesses only two prongs, which are of equal length, barbed on one side, the heads being so attached to the shaft that the sets of barbs point in opposite directions.† See fig. 26. The prongs measure fifteen inches in length, possess thirteen barbs, and are fastened to the shaft with beeswax and vegetable-fibre string.

Type 8.—Stone-headed spear, with the head made of flaked quartzite, and the shaft of reed.

This type is common. The spear is eleven feet long, the stone head varying in length from two to six inches. The stone is chipped from Ordovician quartzite that occurs in extensive outcrop on the Victoria River and elsewhere. The stone is attached with beeswax, resin, and vegetable string.

Type 11.—Short, light spears, with a thin, tapering point of hard wood and a reed shaft.

Common among all tribes on the north-west coast. Those of the *Larrekiya* and *Wogait* are decidedly more neatly finished than those of the *Berringin* and *Ginmu*. See

* *Cf.* E. J. Eyre: Journs. Expeds. of Discov. Centr. Austr., vol. ii., pl. vi., fig. 2; and R. Etheridge: Macleay Mem. Vol., Linn. Soc., N.S.W., 1893, pl. xxxi., fig. 5.

† *Cf.* E. J. Eyre: *Op. cit.*, pl. v., fig. 3.

fig. 27. The spear measures five feet in length; the head or prong is made of mangrove wood.* It is employed principally for settling minor quarrels between two individuals, in which the opponents skilfully dodge the missiles, each dancing grotesquely in defiance to his opponent, by jumping from foot to foot, and holding the arms half-erect and bent at elbow and wrist, while the body is thrown forward and the head back.† See fig. 28. A "close shave" is greeted with a pronounced "irr."‡

Fig. 28.

This light spear, on hitting the ground, skips along the surface, and may be recovered uninjured. A large number of these spears is always available, owing to their easy construction.

Messrs. Spencer and Gillen state that this form of spear "is thrown by the hand, and never with a spear-thrower."§ This must not be regarded as applying to all tribes alike. So far as my observations went, spear-throwers of the type described on page 35 were used specially for spears of this type by all the north-western tribes, with the exception of the *Ginmu*, but there is no reason to doubt that these also use them.

Two varieties of this type must be added:

One is identical with the above in shape and design, but twice as large; the reed shaft measuring four feet and the mangrove head five feet in length. It is used for hunting and fighting; in the latter case, particularly, when a lubra is concerned.

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* Macgillivray defines this type as spears, shafted with reeds, the smallest of which are no bigger than arrows: Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., p. 147.

† *Cf.*, "A single black would hurl his spears one after another at an opposing blackfellow, who would as adroitly avoid them, ducking his head, bending his back, or shifting slightly to one side." Parkhouse: Austr. Assoc. Adv. Science, vol. vi., 1895, p. 642.

‡ This exclamation seems general. Stokes records it of the Port Darwin natives as indicative of fright; also of the King's Sound tribe. *Cf.* Discoveries in Australia, vol. ii., p. 22, and "Muttered signs of approval . . . were given at any good throws or a particularly clever avoidance of the spears." Parkhouse: *Op. cit.*, p. 642. See also H. Basedow: Trans. Roy. Soc., S.A., vol. xxviii., 1904, p. 24, "a subdued 'irr,' partly expressing pain, and partly disgust or temper."

§ The Northern Tribes of Central Australia, p. 676.

In the second variety, a rare form, used by the *Mulluk-Mulluks*, the reed shaft and hardwood head are repeated, with the addition of a small, chipped chalcedony blade fixed with resin to the end of the latter.

Shafts of spears, if crooked, are straightened by holding the bent portion over a block of heated ant-hill earth, on which water is thrown to generate steam.

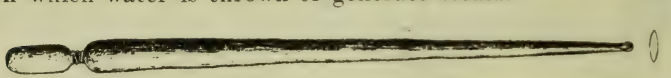

Fig. 29.

SPEAR-THROWERS.

The prevailing type of spear-thrower among the north-western coastal tribes is that shown in fig. 29. It is cut out of light wood, measures four and a-half feet in length; is flat and of uniform thickness (about an inch), both sides being slightly convex. Its breadth is over two inches at the handle, and tapers off to half-an-inch at the end to which the wooden peg is attached with resin. The haft is formed by rounding off the edges, and cutting into the sides of the blade at about four or five inches from the end; round this "grip," kangaroo tendon is often wound. The whole surface of the spear-thrower is coated with beeswax, charcoal, and red-ochre.

The implement is used in throwing all the larger types of spears, with the exception of No. 11, the thrower and spear being clasped by the right hand in such a way that the spear-shaft passes, and is held, between thumb and fore-finger, the remaining fingers holding the handle of the thrower. See figs. 30 and 31.

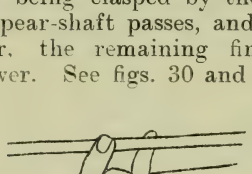

Fig. 30.

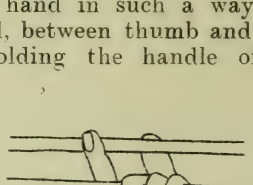

Fig. 31.

A similar though smaller pattern, cut out of light, soft wood, is not uncommon. It is not painted over with ochre or other material.

Another type is four feet in length, two inches wide, and very thin and flexible; the side that rests adjacent to the

spear being flat, the opposite slightly convex. The peg that, in throwing, fits into the pit at the end of the spear is pear-shaped, and made of hard wood, being attached to the blade with vegetable string and beeswax. The handle is thick, circular in transverse section, tapers, and is covered with resin or wax, applied while warm. It is ornamented with rows of small holes pricked out with a fish-bone or small stick, as shown in fig. 32. Experienced men only use this type of "thrower."

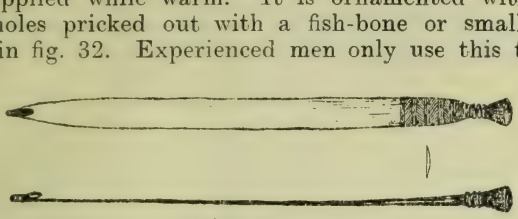

Fig. 32.

The next form is used exclusively for throwing the small reed spears of type 11. It is known as *billiloa (Larrekiya)*, *dun (Wogait)*, or *jun (Berringin)*. It consists of a rod of hard wood, four feet in length, tapering slightly at either end. At one end a lump of resin is attached, and, while warm and soft, it is worked by hand into a blunt point, which fits into the hole at the end of the spear. At about five inches from the handle end a rim of resin is fixed, and from it towards the adjacent extremity a decreasing thickness of similar material. See fig. 33.

Fig. 33.

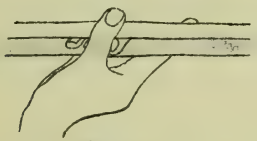

Fig. 34.

When throwing a spear, the hand is placed above the resin rim in the position indicated in fig. 34, the shaft in this case being held by the thumb upon the outer surface of the middle fingers, without the aid of the index finger. The handle end is frequently used to produce fire by the usual rotation process.

The type of spear-thrower described* by Spencer and

* The Northern Tribes of Central Australia, pp. 670 and 671, fig. 224.

Gillen as belonging principally to the *Gnanji* and *Umbaia* tribes, and consisting of a straight stick, with a human-hair tassel as a handle, is comparatively rare among the *Larrekiyas* and *Wogaits*, but has been reported to occur also at Port Essington by Macgillivray.*

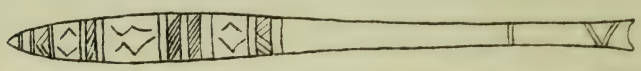

Fig. 35.

Native Sword.

A weapon whose function may be compared with that of a modern sword is constructed of hard-wood in the shape shown in fig. 35. It is flat, with sides slightly convex, and the edges sharp, the length being about four feet. The constricted portion, serving as the haft, may be bound round with vegetable fibre and covered with beeswax to prevent the hands from slipping. This weapon is used both to strike and to ward off blows. When about to receive a blow, a combatant takes the precaution to keep his elbows down close to his body, as otherwise the force of his antagonist's blow may be sufficient to break his guard and cut his arm. His legs, too, he draws in to underneath his body. If his opponent strikes at his hands, he quickly shifts his weapon sideways to receive and guard off the blow.

This is, no doubt, the weapon described from Port Essington by Macgillivray† as a club of compressed form, resembling a cricket bat, with sharp edges, and used only at close quarters.

A fighting-stick, used as a two-handed weapon, from four to five feet in length, circular in section, and tapering

Fig. 36.

towards the handle end, is also used. See fig. 36. It is made of heavy wood, and covered with red ochre and various designs in white. The *Larrekiyas* call this weapon *gwanda*, the *Wogaits wangurre*, the *Sheraits jendönn*, and the *Beringins mileri*.

* Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., p. 147.

† Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., p. 147. See also Brough-Smyth: Aborigines of Victoria, 1878, vol. i., p. 308; E. J. Eyre: Journs. Expeds. Discov. Centr. Austr., 1845, vol. ii., pl. vi., fig. vi; and R. Etheridge: Macleay Mem. Vol., Linn. Soc., N.S.W., 1893, p. 238, pl. xxx.

Although boomerangs are not known to these tribes, a small throwing-weapon *(damatha)* of a flat, spatulate shape, with small handle and sharp edges, is made of heavy iron-wood, from six to twelve inches long. It is gripped by the handle with the right hand, and hurled edgeways, when it flies through the air with revolving motion, to hit its mark with either end; it is capable of making a severe wound on the victim. It is also sometimes used for killing game.

Food and Water Vessels.

The strong *coolemans* or *pitchis* of Central Australia, made of wood or bark, are not used by these coastal tribes, but are replaced by less durable articles made of paper-bark. Boat-shaped vessels of simple design are common. Sheets of paper-bark are folded once along the centre longitudinally, and the ends tied up with vegetable string.* See fig. 37.

Fig. 37.

In a more permanent type, made of stringy-bark, the ends are sloped and stitched together with cane, the sides stayed by three inverted hoops of flexible twigs, and bound crosswise by an equal number of vegetable-fibre ropes. The sides are kept rigid along their central edge by stitching rods to them. See fig. 38.

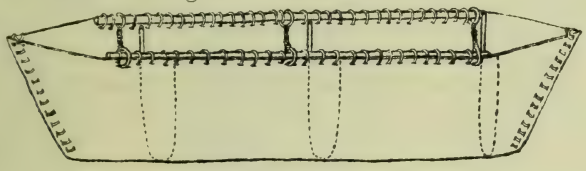

Fig. 38.

Provisional carriers are fashioned out of a long piece of bark by folding it once upon itself longitudinally, then twice across its length into the shape indicated by fig. 39. The women carry this implement either under their arms or by means of the sling described and shown on page 26. In it are stowed the gatherings of the day, such as roots and seeds.

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* *Cf.* W. E. Roth: North Queensland Ethnography, Bulletin No. 7, Brisbane: by authority, 1904, p. 30, fig. 220.

Small articles are rolled up in paper-bark, the roll folded in its centre and tied together at the open ends with grass or fibre.

Infants, too, are wrapped in paper-bark and carried under the arms of their mothers.*

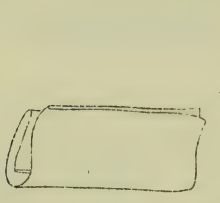

Fig. 39.

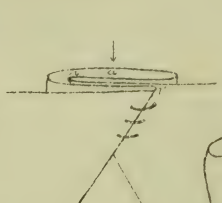

Fig. 40.

Fig. 41.

Water-vessels and baskets are constructed out of the leaves of the fan-palm. A leaf is folded at the edge opposite the stalk in the manner shown in figure 40, the overlapping folds *b* and *b'* being stitched together along the outer edge. The opposite side, containing the stalk, is treated similarly. The stalk is next bent round, and its end passed through the gap *a*, formed by the union of *b* and *b'*, when the end is turned back and tied to itself higher up, thus forming a convenient handle. See fig. 41. A similar type has been recorded from Port Essington by Macgillivray,† and a basket containing water from Luxmore Head by King.‡

Large shells of *Melo diadema* and *Megalatractus aruanus*§ are generally employed for drinking cups, small water vessels, and for bailing purposes; in the last-named case, both for scooping the water from a native well, and for removing it from their small canoes.

A hole is knocked in the body-whorl of these, and may be subsequently enlarged by grinding, so that part of the hand can pass through and grip the columella as a handle. The latter go by the names *maraba (Larrekiya), jinbi (Wo-*

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* *Cf.* W. E. Roth: Ethnological Studies, p. 183, pl. xxiv., fig. 436.

† Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., p. 146.

‡ Survey of the Intertropical Coasts of Australia, 1827, vol. i., pp. 111 and 112.

§ *Cf.* W. E. Roth: North Queensland Ethnography, Bull. No. 7, Brisbane: by authority, 1904, p. 29.

gait and *Berringin)*, and *jinbiwa (Sherait)*; the former by *malarinda (Larrekiya)*, *ngaremang (Wogait)*, *ngaremuk (Sherait)*, and *Ounga (Berringin)*.

Domestic Utensils.

An implement used for cracking the nuts of *Cycas media* consists of a piece of hard wood, about one foot in length, shaped like a cricket-bat. The nuts are held against some resisting surface, such as a rock or tree-root.

Pointed yam-sticks, similar to the Central Australian type, are among the belongings of the women of all tribes.

Open-mouthed, cylindrical baskets, with straight sides and curved bases, projecting upwards to a blunt cone inwardly, are plaited of flexible twigs after the pattern represented in fig. 42. The edge of the mouth is strengthened on the inside by a stouter twig, and by several vegetable strands on the outside, the upright bars of the pattern terminating between the two series, to which they are attached by cross-

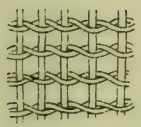

Fig. 42.

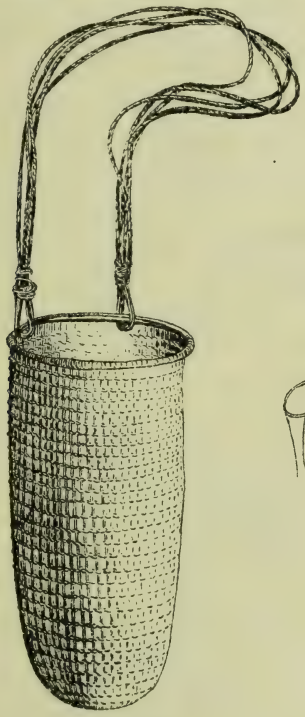

Fig. 43.

Fig. 44.

winding. See fig. 43. To one side of the rim a long band, consisting of several strings, is tied at two points in the shape of a loop. This is hung over the crown of a gin's head, the basket hanging down behind. See fig. 44.

Large, flat-folding "dilly-bags," with long carrying-bands, and the common chain-twist pattern in vegetable strands, are usually carried about in the same way as that just described. At times, however, they are suspended from the neck, or if they are very heavy they are carried on the head. When laid flat they measure one foot four inches in length, and decrease in width from the base (one foot) to the mouth (nine inches). There is no separate base, but the two sides of the folded bag are merely knitted along the bottom.

The mouth-edge is neatly finished off by transverse winding, and a carrying band is attached at either corner of the folded bag.

Smaller bags of a somewhat similar construction are worn round the neck by the men, to carry small, useful articles. They measure, when folded, eight inches in length, and four inches in breadth at the base.

Vegetable-fibre Strings.

String made of twisted vegetable-fibre has frequently been mentioned. This is often made by gins from palm-leaves in the following manner:— One of the long serrations of the fan-shaped leaf is folded sharply near its end, the folded part seized between thumb and finger, and, with a sudden jerk, snapped off. See fig. 45. The outer epithelial covering of the frond thus locally detaches itself at the fracture, and curls up into several narrow strips that project beyond the break. These are stripped downwards as long, narrow pieces. Two of such are held, side by side, between thumb and forefinger of the left hand, and rolled with the palm of the right hand on the thigh, each strip rolling up separately. When released by the left hand (but still held by the palm of the right), the rolled lengths twist loosely round one another, and are more firmly coiled by a backward roll of the right hand. Short lengths are thus made, junctions with fresh strips being made by holding the ends of old and new lengths together, and applying the same manipulation. Two strings thus pro-

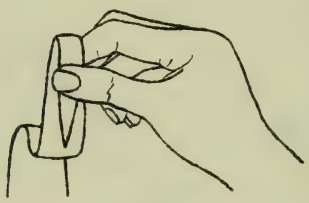

Fig. 45.

duced are generally knotted at one end, and twisted by a similar method into one. Women invariably perform the rolling action on their thighs; some men use the soles of their feet on account of the growth of hairs on their legs.

Personal Ornaments.

Head-bands.—String made from fur, human hair, and vegetable-fibre are used in the making of head-bands, which are worn as a fillet round the head by young and old. They are made of long lengths of string, coiled into a ring, and bound round by more string for a short distance. Those of the men are often made of opossum fur covered with red-ochre.

The head-bands of the women consist of about four circlets (three and a-half feet in diameter) of vegetable-fibre, tied together by transverse winding for about two inches. These, by being twisted figure-of-eight fashion, form a head-band of eight strands. When dancing at corrobborees the bands are unfolded to the original size, and held in the hands by passing an end under each thumb, much as a skein of wool is held to be unwound.

This form is also worn by children, and they, in addition, construct simpler forms by bending long, slender rootlets of the banyan or other tree spirally, three or four times round one another, and knotting the ends together. See fig. 46. An ornamental appendage is sometimes tied to the head-band, so that it rests over the forehead. One consists of the tip of a wild-dog's tail fastened with human-hair string and beeswax; another of the shell of a pearl oyster *(Meleagrina margaritifera)*, similar in construction to that of the pubic appendage described on page 45.

Fig. 46.

Forehead-bands are made by joining about twenty-five opossum-fur strings closely together to form one flat band measuring nearly one foot in length and one and a-half inches in breadth. The opposite ends of the component strings are divided into two lots respectively; each pair, at either side, being tied into the form of a loop, to which string is attached to be knotted behind the head. See pl. ii. The band is coated with white kaolin, and decorated with vertical bars of red ochre.

Ornate forehead-bands are made with teeth of kangaroos. A number of incisors of these animals are cleaned by rubbing their enamel surface against the cutting edge of the native's teeth, then a long string, twisted from the fibre of palm-leaves, is wound in succession from the root of one tooth to the other in a row; the string, after passing

backwards and forwards three times, having its ends fixed at either side by separate ties. The intervening spaces between the teeth are interwoven and filled with beeswax. Thus the white enamel-surfaces only are exposed at the base of the black band, their roots being embedded in the wax. See pl. i.

Single teeth of the kangaroo are utilized somewhat similarly. After cleansing the enamel face as described, a lump of beeswax and a tooth are warmed at a fire; then the requisite amount of wax is scooped up with the root of the tooth, and worked with the fingers into a small globular mass round that end; the fingers during this process being kept greasy by rubbing them over the nose, thus preventing the wax from sticking to them. A little charcoal is next crumbled between two fingers, and pressed into the surface of the wax. A central lock of hair is squeezed into the wax of the ornament, which is worn over the forehead. See fig. 47.

Fig. 47.

The curls of warriors are at times partly embedded in beeswax and ochre, the head thereby becoming covered with numerous cylindrical bodies, from the lower extremities of which the ends of the bundles of hair spread out and curve upwards.

Necklaces.—Reference has already been made to the grass necklaces worn during initiation ceremonies (page 10). They are made by threading short segments of dry flower-stalks of grass upon thin fur* strings. About ten of such threaded strings, about eight inches in length, and bearing loops at the ends, are tied together at both ends by single pieces of human-hair string, which serve to tie the ornament round the neck. See fig. 48 and pl. ii.

Fig. 48.

Closely allied forms are made by substituting the grass segments by truncated shells of *Dentalium*, when as many as twenty-six strings are grouped together.

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* *Cf.* J. Macgillivray: Narrative of a Voyage in H.M.S. "Rattlesnake," 1852, vol. i., p. 146; and W. E. Roth: Ethnological Studies, p. 3, pl. xiii., fig. 264.

Chest-bands.—About forty thin vegetable-fibre strings are wound into a skein, like that used in the head band previously described. The circumference of each circle thus produced measures from three and a half to four feet, a certain proportion of which (nine to twelve inches) is bound round, circumferentially, so that it becomes a solid cord. The strings are divided into two lots, each of which is tied round near the main rope at either end for a length of about one inch, to keep the two halves separate. (See fig. 49.) The ornament is worn principally by women in the manner shown in figs. 50 and 51. The bound portion rests vertically along the back, and each of the two halves passes over one shoulder, diagonally across the chest and under the opposite arm, to meet the lower end of the vertical cord.*

Fig. 49.

Fig. 50.

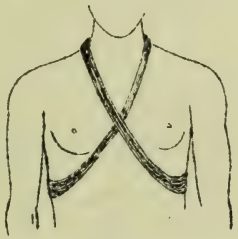

Fig. 51.

Smaller forms of this ornament are worn round the neck, most often by men. (See pl. ii.)

* *Cf.* R. Etheridge: Macleay Mem. Vol., Linn. Soc., N.S.W., 1893, p. 247; and Spencer and Gillen: The Northern Tribes of Central Australia, 1904, p. 694.

Armlets.—Reeds are split longitudinally into long, thin strips, which are scraped into pieces of uniform breadth with stone knives. In the latter process, one end of the strip is tied round the great toe of the right foot, from which it is passed between that toe and the next of the left foot, and the other end held in the left hand. The right hand is thus free to do the scraping. See fig. 52. The prepared strips

Fig. 52.

are neatly plaited into armlets that are worn by male and female round the upper arm above the elbow. See pl. ii. With age, these armlets become very tight-fitting, often pressing deeply into the flesh, and at times have to be cut on this account. The armlet has the following tribal names:—*Mirrakma (Larrekiya), tchellörra (Wogait* and *Berringin),* and *pinbin (Sherait).*

A broader armlet is used during certain ceremonies. It is one and three-quarter inches broad, and consists of about twelve narrow series of five plaited strips of cane, subsequently knitted into one by a close meshwork of opossum-fur strings, passing transversely from one series to the other, alternating over one and under the next.

Waist-girdles.—Waist-girdles are worn by men, and are made of twisted human-hair string. About thirty string circles are tied together at opposite ends of a diameter, thus forming, when pulled out, a bundle of sixty parallel strings. These are loosely twisted together to form a coil about two feet in length, which is tied round the waist by a similar

Fig. 53.

piece of string. This article serves, not only as an ornament, but is also used as a belt, in which various implements and weapons are carried, by thrusting them between belt and body. A warrior was observed carrying a stone tomahawk in this manner, and, in order to stop the swinging of the dependent handle in his movements, it was made to rest in the cleft of his buttocks. See fig. 53.

The spiral belts of stringy-bark have already been alluded to. Their length, when uncoiled, measures up to eight feet, their width three inches. See pl. ii.

Pubic Tassel.—In the description of various ceremonies the pubic tassel has been mentioned. It consists of a great number of twisted strands of opossum fur, bound to a central piece, which is tied to the waistband, either by two separate terminal strings, or by means of a thick, single one, passing from the top of the tassel. See fig. 54. In the latter case, the string ends in a large knot, that is simply tucked underneath the waistband.

Fig. 54.

The tassel is, at times, replaced by the shell of the pearl oyster *(Meleagrina margaritifera)*, two holes being, for this purpose, drilled near the hinge-line, to receive a string, whose ends are attached to a thick knot or small rod, passed under the belt. The shell is usually worn with its edge and rough exterior surface ground smooth.

Tribal Communications.

"Message-sticks."—A tribe, desirous of carrying on strife with its rival, sends to them a well-known message-stick by a messenger. Among others, two types prevail that are used according to whether the trouble is the result of disagreement between the men from sundry causes, independently of the women, or whether it has been caused by a woman—*e.g.*, a case in which a man has stolen a wife from a strange tribe, and the rightful owner wishes to avenge the theft.

In the former case, the "message-stick" consists of two equal internodes of reed, about one inch in length, squared off at the ends by cutting and subsequent burning on a red-hot piece of charcoal. These are tied together, side by side, with fur-string, which passes through the length of both reeds, and is knotted into a loop at one end. See fig. 55.

Fig. 55.

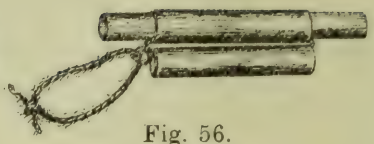

Fig. 56.

In the second case, where a woman is concerned, the "stick" is so far similar; but, in addition, has a longer and thinner internode passed through one of the other two, fitting securely into it. See fig. 56.

The messenger, dispatched by the tribe, fastens the stick underneath his forehead-band by its loop, and hurries to the party concerned. After it has been noticed by all present, he hands it to him who should receive it.

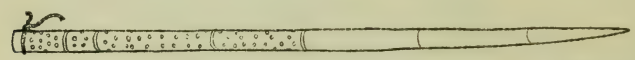

Fig. 57.

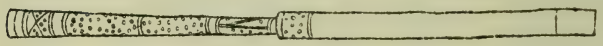

Fig. 58.

Other "message-sticks" that are known, at least to the *Larrekiyas*, *Wogaits*, and *Berringins*, serve principally for the summons and invitations to initiation ceremonies. One form (fig. 57), measuring from three to four feet in length, tapers to a point at one end, while at the other it has a piece of fur-string attached. The other (fig. 58), about eighteen inches long, consists of two segments, the base of one being made to fit into the other. They are both made from wood coated with red ochre, upon which designs are painted in white, in the patterns figured.

The call to initiation ceremonies of the *Wogaits* is the "*dell*" (or *diya* of the *Berringin*)—a message-stick of bamboo, from four to five feet long, painted transversely with alternate bands of red ochre, the glossy surface of the bamboo having been previously scraped in the parts that are to take the paint.

Silent Correspondence.

A conventional system of signalling and communicating with one another, at distance, by gestures, is understood by all the tribes.

Firstly, when the attention of a person a long way off is to be attracted for parley, the native stands erect, with his legs astride, throws his arms outwards, and continues waving them from a position in which, with elbows bent, the hands rest on the head, to that in which the arms are extended down either side of the body. While he is executing these movements the native keeps up a shrill, piercing shout, no matter whether the other party be within hearing distance or far beyond it.

Next, if he wishes him to approach: Maintaining the erect posture, both hands are thrown up above one shoulder, then swept, in extended condition, before his body to well behind it on the opposite side, and, in so doing, he bends his head and body forward from the hips.

If he means to indicate that he intends going to the stranger, the arms are thrown outwards from his chest in the direction of the latter person. Lastly, if the stranger is to remain where he is, both arms are held, bent at the elbows, with the open palms, which are directed towards the distant party, resting at about the same level as his head, or slightly above it. They are then swept round in a vertical plane to a position directly below the starting-point.

In every case the actions are repeated until the distant man has responded.

Fig. 59.

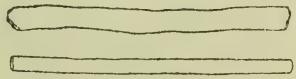

Fig. 61.

Fig. 60.

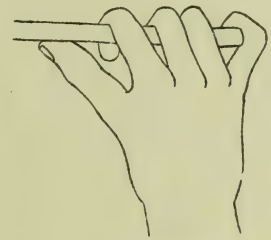

Fig. 62.

Musical Instruments.

The music-sticks that are used to beat the accompaniment of corrobboree chants consist of two pieces—one, about nine inches long, flat, rounded off at one end and notched at the other, is made of ironwood *(Erythrophlaeum laboucheri)*.

See fig. 59. This is held in the left hand, as shown in fig. 60. The other, the beating-stick, is simply a smaller rod of circular section, made of mangrove-wood *(Rhyzophora* sp.). See fig. 61. It is clasped by the right hand in either of two ways: In one, the end of the rod is pressed against the little finger, all other fingers holding it, with the thumb underneath. See fig. 62. In the other, the end rests against the side of the middle finger, the thumb and index finger only holding it.

In performing, the ironwood is struck by the mangrove rod at about two-thirds its length from the notched end, producing a loud, ringing note.

Fig. 63.

The bamboo trumpet, or drone-pipe, is made by cutting a fairly thick bamboo *(Bambusa arnhemica)*, either curved or straight, into a length of from four to five feet, and breaking out its diaphragms, while green, with a rod and heavy stone. What remains of the septa is subsequently burnt out with a fire-stick. The outer surface is decorated by scratching designs upon it with a stone knife. See fig. 63.

When a bamboo is not available, a provisional "trumpet" is constructed by breaking the stem of a hybiscus and carefully removing the bark intact, in the form of a long pipe. This form does not last for more than a night.

The instrument is used as an accompaniment for corrobboree chants, the operator blowing into one end with a vibratory motion of his lips. Examples of the sounds produced are given on page 12. A droning, mournful succession of notes is emitted, and kept up without a break, the performer breathing all the time through the nostrils, as when a blowpipe is used. Before play, the pipe is usually moistened on the inside with water, which is said to improve its tone.

It is interesting to note that Wilson, in 1835, in referring to a native dance at Raffles Bay, wrote* that the music on that occasion was produced by one of the performers from a hollow tube.

Stokes found the instrument, referred to as *"ebroo,"* in

* Narrative of a Voyage round the World, 1835, p. 87.

use among the natives at Port Essington in 1838, and wrote* that they blow through it with their noses. This, in all probability, is a mistake.

Leichardt also found it at Raffles Bay in 1845. He calls† it *"eboro,"* and describes it as a long tube of bamboo, by means of which the natives variously modulated their voices.

The same instrument is also recorded from Port Essington by Macgillivray‡ as the *"ibero,"* a piece of bamboo, three feet in length, which, by blowing into it, is made to produce an interrupted, drumming, monotonous noise, and by Keppel§ as a bamboo tube through which a monotonous sound is transmitted by the performer's breath; and Coppinger,¶ in the vicinity of Port Darwin, observed a hollow reed, about four feet in length, that was used like a "cow-horn," with the production of a rude burlesque of music.

More recently, Etheridge has described‖ these bamboo trumpets from the Alligator River tribes, of the Northern Territory.

The instrument is known to the various tribes as *mamillima (Larrekiya)*, *kanbi (Wogait)*, *molk (Sherait)*, and *kanbi (Berringin)*.

Manufacture.

The shells** of large helices *(Xanthomelon pomum)* are much used in the making of weapons and implements. A hole is carefully tapped into the main whorl, leaving the edges of the fracture as sharp and abrupt as possible.

For rasping and smoothing surfaces of wood, the shell is held, by the little finger of the right hand, at the open end of the body whorl, so that the made aperture rests below the finger. Held in that position, the lower edge of the hole

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* Discoveries in Australia, Voyage H.M.S. "Beagle," 1837-1843 (London, 1846), vol. i., p. 394.

† Journ. Overland Exped. in Australia from Moreton Bay to Port Essington, 1844-1845 (London, 1847), p. 534.

‡ Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., p. 151.

§ A Visit to the Indian Archipelago, vol. ii., 1853, p. 163.

¶ Voyage of the "Alert," 1883, p. 204.

‖ Macleay: Mem. Vol., Linn. Soc., N.S.W., 1893, p. 242, pl. xxx., fig. 7, and pl. xxxi., fig. 6. See also T. Worsnop: Pres. Address Sect. Ethnology, Austr. Assoc. Adv. Science, 1895, vol. vi., p. 145, and "The Prehistoric Arts, Manufactures, Works, Weapons, etc., of the Aborigines of Australia," Adelaide, 1897, p. 155.

** *Cf.* W. E. Roth: North Queensland Ethnography, Bull. No. 7, 1904, p. 21, and figs. 109 to 115.

forms the rasping surface, which is only worked upwards. The main portion of the shell during this process, therefore, lies against the outer side of the palm. See fig. 64.

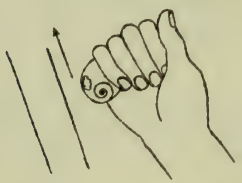

Fig. 64.

Fig. 65.

When the point of a spear or other weapon is to be sharpened, the prepared shell is held by the index and middle finger of the right hand, so that the puncture is underneath. The point of the weapon is then placed between the shell and thumb, which latter presses the point against the shell, the rasping being done only towards the body, in the direction indicated by the arrow in fig. 65.

A strong bivalve shell *(Cyrena essingtonensis)* is also used in the final process of chipping stone spearheads and knives. The umbonal portion of the shell, with the convex surface outwards, is held firmly by all fingers of the right hand, in such a way that the ventral edge is away from the palm of the hand. The latter border is pressed against the chipped edge of the stone head, gripped by the left hand, and by a careful wrenching of the right hand, in such a direction that the thumb moves downwards, the requisite chipping is accomplished.

For this final process, a fragment of quartzite or flint is often used, instead of the shell—that is, after the preliminary flaking of the stone. This is used in the same way as the shell.

A bivalve shell is also used for cutting wood. For this purpose the shell is held, dorsal surface upwards, between thumb and middle finger, the index finger passing round the umbo and convex surface. The ventral edge is placed against the piece of wood, which is held with the remaining two fingers. By combined pressure and half-circular forward motions of the right hand the wood is cut through. See fig. 66.

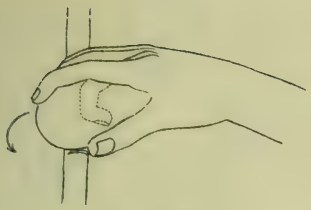

Fig. 66.

Fig. 67.

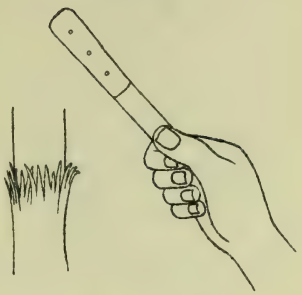

Fig. 68.

It is curious to note that if a native be given a steel knife, it will be used for cutting in much the same manner as the shell. The handle of the knife is held by the thumb against the base of the index finger, while the blunt edge of the blade rests against the palm. All fingers grasp the rod and help to press the stick against the cutting edge, and impart the upward, half-circular motion to the hand. See fig. 67.

So, too, when chipping a rod, not the handle, but the blade of the knife is held in the hand, the weight of the former giving momentum to the movements of the knife. See fig. 68.

Miscellaneous.

The most general mode of carrying an infant is to sit it astride on its parent's shoulder, the child holding on to the parent's head for support. On the march, a child often falls asleep in this position, and then the bearer may be seen holding one of his hands up as a cushion, upon which the child may rest its head.

Less frequently to be seen is the method usually adopted by whites, in which the child is held by both arms. The fact that the hands are thus preoccupied no doubt accounts to some extent for the limited use of this method, which is rarely seen further south. See fig. 69.

It has already been stated that infants are wrapped in bark of trees, and carried under the arms of their mothers.

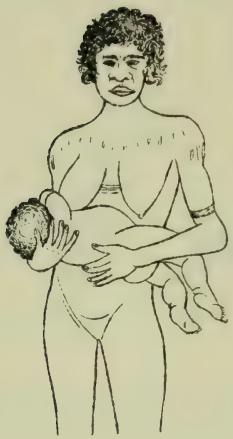

Fig. 69.

Fig. 70.

As among other primitive people, the strange habit of standing at ease on one foot prevails. One leg is bent, and its foot placed with its heel above the knee of the other, while the body is steadied by a stick or spear-thrower, held in the hand. See fig. 70. It may be mentioned that a man is rarely encountered without this implement. To be without it is not regarded as correct.

When a waterhole or billabong is reached, a decidedly animal-like method of drinking is often resorted to. The native wades into the water for some depth, then, placing his hands on the knees, he stoops down, places his mouth to the water, and drinks. See fig. 71. On a hot day, after he has quenched his thirst, he will usually cool his body by pouring water on to his head.

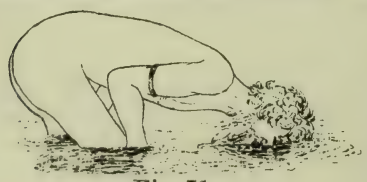

Fig. 71.

Rivers have frequently to be crossed by swimming, notwithstanding the numerous crocodiles that abound. Any personal belongings, that are not to be wetted, are wrapped in paper-bark, and the parcel held high and dry in the left hand, while the right arm propels. When long stretches of water have to be crossed, a log of wood is pushed along in front of the swimmer, and on it the belongings are carried.

With conditions so favourable, it is surprising that these coastal tribes have not developed greater power of navigation* and become capable of fashioning more seaworthy crafts than were observed; and, indeed, the tribes that have come into contact with Europeans and Asiatics have proved themselves to be well adapted for the art. But it is very doubtful whether the well-shaped dug-out canoes of the *Larrekiyas* near Port Darwin and those of the *Wogaits* beyond Point Charles are of native origin. Probably their manufacture is a product of the contact with Malays or some other race.

Macgillivray, in 1852, wrote† that "formerly bark canoes were in general use, but they are now completely superseded by others, hollowed out of the trunk of a tree, which they procure ready-made from the Malays, in exchange for tortoise-shell and in return for assistance in collecting trepang."

Both Flinders‡ and King§ have described bark canoes from the north coast of Australia.

Stokes relates¶ how Captain Wickham, when he discovered Bynoe Harbour, found, opposite the small projection of land he subsequently called Raft Point, "a raft carrying two women and several children, which was being towed by four or five men swimming alongside and supporting themselves by means of a log of wood across their chests." By buoying their body with the same means, several natives attempted to swim out, against a strong tide, to our lugger, the "Venture," when at anchor in Treachery Bay. The same has been recorded by His Excellency the Governor, Sir George R. Le Hunte,‖ from Treachery Bay, also. His Excellency points out

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* Professor Klaatsch has recorded the entire absence of the knowledge of navigation among the north-western tribes of Western Australia: Zeitschrift für Ethnologie, 1906, p. 794.

† Narrative of a Voyage of H.M.S. "Rattlesnake," 1852, vol. i., pp. 146 and 147.

‡ Voyage to Terra Australis, 1814, vol. ii., p. 198.

§ Survey of the Intertropical Coasts of Australia, 1827, vol. i., p. 90.

¶ Discoveries in Australia, vol. ii., p. 15.

‖ Rep. Visit to Northern Territory: Parl. Paper, No. 49, Adelaide, 1905, p. 4. See also P. P. King: Survey of the Intertropical Coasts of Australia, 1837, vol. i., p. 38.

that the Fijians in a similar way employ the trunks of banana-palms to assist them in their swimming.

Native Art.

Rock Drawings.—In 1841 Sir George Grey published* reproductions of drawings he found in sandstone caves on the Glenelg River in the north-west of Australia, and about these much discussion† has taken place as to whether they were the work of aborigines or not. The recent discovery, however, of similar designs, in the Kimberley district, by F. S. Brockman‡ and party places the question beyond dispute. The drawings certainly demonstrate a greater development of talent than the average Australian blackfellow is usually credited with; and that this fact may be originally due to contact with shipwrecked sailors is supported, among others, by Dr. F. M. House§ and Professor Klaatsch.¶

As a very general remark, the drawings of the natives under consideration in the present paper, though of the same type as found throughout Australia, may be classed a step in advance of those of the central and southern tribes, so far as they have been placed on record. In the same way, the music and rhythm of the chants of the northern tribes may be said to be a little more pleasing to the ear than those of the Central Australian.

At Blunder Bay, on the Victoria River, east of Endeavour Hill, a low cave, or rock shelter, was discovered in the quartzite range on the river frontage. The numerous mortars fashioned on the slabs of rock for grinding ochre, utensils, soot-covered walls, and food remains showed that this cave has been, and is still, a frequent meeting-place of the blacks. The sides and roof of the cave were covered with many rock drawings, the most conspicuous of which are represented on pls. xi. and xii.

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* Journals of Two Expeditions of Discovery in North-West and Western Australia, London, 1841. Plates republished by T. Worsnop, Presidential Address, Section Ethn. and Anthrop., Austr. Association Adv. Science, vol. vi., 1895; and The Prehistoric Arts, Manufactures, Works, Weapons, etc., of the Aborigines of Australia, Adelaide, 1897.

† *Vide* Remarks on the Probable Origin and Antiquity of the Aboriginal Natives of New South Wales, by a Colonial Magistrate (Hall), 1846; Brough-Smyth: The Aborigines of Victoria, vol. i., 1878, p. 289; J. Matthew: The Australian Aborigines: Journ. Roy. Soc., N.S.W., 1889, vol. xxiii., p. 414.

‡ Rep. Expl. N.W. Kimberley, 1901, Perth: by authority, 1902.

§ Appendix C, of Rep. Expl. N.W. Kimberley, 1901.

¶ Zeitschrift für Ethnologie, 1906, p. 787.

Of this series, perhaps, the most striking is fig. 1 of pl. xi., which measures about twelve inches in height, and is painted in white pipeclay, such as is used for personal ornamentation at ceremonies. It represents a woman in a peculiar attitude, with her arms thrown apart, and one leg in a position strongly suggestive of the stamping movement of corrobborees. The arms and hands, too, look as if the artist had intended them to convey the same idea; for, as has been already alluded to on page 41, in the corrobboree dance of the gins, a long skein of vegetable strings is often held between the hands and worked backwards and forwards in a way which, from a distance, resembles the action of a fiddler's bow. No facial or other detailed features were discernible on the figure, and it is, therefore, doubtful whether the drawing is intended for a front or back view. The extraordinary large breasts suggest that it represents an adult. It will be noticed that three fingers only are given to each hand, while the toes are not differentiated.

Large drawings of crocodiles are plentiful. The best finished is shown in fig. 2 of pl. xi. It measures five feet three inches in length, and is drawn in red ochre, while its outline is defined with white pipeclay, made into a paste with water, and dabbed on with the finger. The head and tail are decidedly apparent, the latter tapering, the former being marked by a bulge on the upper surface to indicate the prominent frontal bone of those reptiles. The limbs are not divided into separate segments, but are shown as straight, outwardly directed members of unequal length, and terminating in each case in five claws, this number being correct for the fore, but one too many for the hind, limbs.

Fig. 3 of the same plate delineates the same animal in red ochre only, but it is more crudely drawn. The limbs are without claws, and resemble more the paddles of a turtle in shape.*

Several other forms of a similar type, with very slight modifications in design, and varying in length from three to five feet, are among the group. Figs. 1 and 2 of pl. xii. are identical with that last described, except that, in the latter, transverse bars have been drawn in yellow ochre, probably to represent the rows of horny scutes. The alternate placement, too, of the forelimbs of this design suggests motion.

Fig. 3 of pl. xii. represents two crocodiles, the smaller, done in yellow, being placed within the outline of the latter, which is in red.

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* A "saurian type" of figure in red ochre on granite has been recorded from Cloncurry, Queensland, by W. E. Roth: Ethnological Studies, p. 116, pl. xiv., fig. 280.

In fig. 4 of the same plate we have a sketch, three feet in length, in red, of what is no doubt intended for the head, body, and tail of a crocodile, with transverse bars across its length, as in fig. 2. The legs, however, are missing.

Fig. 5 of pl. xii., measuring two feet in length, is drawn in red ochre, and depicts the lower portion of a limb of a crocodile, which, if the number of claws is correctly drawn, is a hind leg.

Fig. 4 of pl. xi. is of doubtful nature. It is painted in yellow ochre, while at its lower extremity, a peculiar subsidiary design in red surrounds it. The red portion may have belonged to a previous, and, now, partly obliterated, drawing. I am unable to offer any suggestion as to its meaning. A *Larrekiya* youth traced its resemblance to a frog, and, no doubt, the general squat shape and broad, round end does suggest this view.

In fig. 6 of pl. xii. we may find an interest in spite of the design having become considerably obliterated through long exposure, from the fact that the radial markings of the little that remains remind one slightly of a feature in some of the paintings figured by Grey.* The only other explanation I can offer is the small ornament constructed of fur and beeswax, worn under the forehead-band of the men.

On the walls of this cave, also, are numerous reproductions of negative imprints of hands, made in the manner that has been previously recorded. The palm of the hand is held flat against the rock-surface, the mouth filled with a thin paste of pipeclay, or ochre, suspended in water, and these contents squirted around the hand. The result is that a patch of rock is stained red or white, as the case may be, except where it has been protected by the hand. In many instances the imprint is subsequently tinted with a different pigment, or in some cases a ground colour is given to the rock before the imprint is made.

Figs. 7, 8, and 9 of pl. xii. demonstrate these productions. which show that imprints are made both from the right and left hand.

Fig. 10—a long yellow, sinuous curve—may possibly have been suggested by the form of a serpent; but it is doubtful. As to the remaining figures on this plate, Nos. 11 and 12, I have no suggestion to offer.

I am indebted to Mr. W. Holtze for photographs of another group of rock-drawings, secured from the Katherine River. These are all drawn in pipeclay.

* Journals of Two Expeditions of Discovery in North-West and Western Australia, London, 1841, vol. i.

A creditable design of a lizard is the best preserved of the group (pl. xiii.). It is well proportioned, and from the long, slender head and neck of the figure, one might safely refer it to the monitor (*Varanus* sp.), which is there plentiful and forms an object of their hunts. A decided differentiation between head, body, and tail has been attempted, the last-named tapering to a long, fine end. A long, bifurcated tongue is extruded, which is in conformity with a frequent habit of these animals. The left forelimb, only, possesses the correct number of claws.

On pl. xiv. are shown two drawings, which may probably be meant for representations of the archer fish (*Toxotes* sp.) that inhabits the waters of this region. This fish is noted for its habit of capturing insects resting on the leaves of water-plants by shooting a stream of water upon them from below. The general shape, position of the fins, straight antero-dorsal contour, and strong dorsal spines support the above inference. The lateral line in both drawings seems indicative of the row of dark circles usually ornamenting the local species; if that be so, the band is too central in the figure, and should be nearer the dorsal border.

The next, and different, variety of fish shown on plate xv. may be referred to a species of *Therapon*, on grounds of general similarity of shape. The species inhabiting the local waters is characterized by the short, square-cut tail, and the long, low, spiny, postero-dorsal fin that, it is clear, the figure means to represent. The sketch, at first sight, gives the impression that spines are distributed over the greater part of the body. The effect is very likely due to streaking of the pigment by the weather, rather than to design.

Drawings on Bark and Implements.—Reference has already been made to the emblems painted on the chests of messengers and visitors to another tribe, or of those who are returning after a long absence.

Somewhat allied to these are the pictorial representations of familiar objects upon implements and pieces of bark.

A very instructive series of pipeclay drawings on bark was obtained from the Katherine River, for the photographs of which I have again to thank Mr. W. Holtze.

The most true to nature, and perhaps the best-executed figure of the series is that of a kangaroo in profile (pl. xvi.). The sense of proportionate size of the various parts is not bad, as are also their details. From the attitude of the kangaroo it is probably intended to be dead; this is suggested mainly by the drawn-up tail and clutched fore-claws.

The figure on plate xvii. represents an emu. Its peculiar feature is the upturned position of the head, which is not very clearly delineated. The strong, muscular, upper portions of the legs have been rather exaggerated by the artist. The plump body of the bird is true to nature, and the correct number of toes has been assigned to each leg.

The following design (pl. xviii.), which is less favourably preserved, depicts either a bustard (*Eupodotis australis*) or a crane, in a rather unnatural attitude, which also may be that of a dead bird. The long, thin neck is more suggestive of a crane than a bustard. A portion of another bird is also indistinctly visible.

Fig. 72.

A group of drawings on a single piece of bark was found by Mr. P. Foelsche at Port Essington, and is represented in fig. 72.

One of the figures repeats the salient features of the kangaroo already described.

The figure on the right-hand side illustrates the method of hunting the turtle by harpooning it from the bow of a canoe, the rope that is attached to the harpoon being plainly visible and connected with the canoe.

The figure of a human being adjacent to this group may or may not belong to the former. It is of a character similar to the drawing described from Blunder Bay; while the long breasts suggest a woman, the opposite sex is also clearly indicated in the sketch. The hands and feet are crudely represented, the latter being abnormally large.

The largest figure, on the left hand, is that of a boat with a mast and tackle, and three men aboard. These are not nude, but clothed, and consequently not intended to be aborigines. The boat, which is quite different from the native canoes, may be intended for one of the

Malay proas that have been in the habit of visiting the north coast of Australia for many years past.*

A photograph of similar bark drawings said to come from east of Port Darwin (possibly the Roper River), is in the local museum at Palmerston. By kind permission of the Curator, Mr. N. Holtze, I have made the tracings reproduced on pl. xix. Practically the same objects as those figured in the preceding plates are represented.

The kangaroos of figs. 1 and 2 are not unshapely, and the attempt to reproduce a bird of prey perched upon the one in the former figure is unusual. Wickham, in his "Notes on Depuch Island,"† figures a group in which a similar occurrence is depicted. In the explanation he writes that it "appears to be a bird of prey having seized upon a kangaroo-rat."

The remaining drawings of fig. 2 are, no doubt, intended to represent turtles.

Figs. 3, 4, and 5 are well-finished designs of fish of several species.

Fig. 6 clearly represents a saw-fish (*Pristis* sp.); fig. 7, a group of dugongs (*Halicore australis*); fig. 8, two turtles; and fig. 9, a crocodile. Judging from the position of the eyes, the last-named figure is intended to represent the dorsal surface of the animal, but it will be seen that the artist also clearly drew the anus.

Fig. 10 is an unusually bold design of a snake.

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In conclusion, I have to acknowledge my indebtedness to Messrs. P. Foelsche and N. and W. Holtze for the instructive series of photographs, and to Professor E. C. Stirling, C.M.G., F.R.S., for kind assistance with my manuscript.

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* *Cf.* Flinders: Voyage to Terra Australis, 1814, vol. ii., p. 228.

† Journ. Roy. Geogr. Soc., Lond., vol. xii., 1842, p. 79, fig. 71. Stokes subsequently published it in his "Discoveries in Australia," 1846, vol. ii.; and more recently Worsnop: Pres. Address. Sec. Ethnology and Anthropology, Austr. Assoc. Adv. Science, vol. v., 1895, 1, *et op. cit.*

COMPARATIVE VOCABULARIES* OF THE LARREKIYA, WOGAIT, SHERAIT, AND BERRINGIN TRIBES.

ENGLISH.	LARREKIYA.	WOGAIT.	SHERAIT.	BERRINGIN.
boy	ngim	bambad	mäunmin	yerra
girl	banngelö	midalöng	darawurru	tchiparre
old man	lörropa	ngamuyuk	ponduburruk	börlö
old woman	gumul	ngabali	mangut	dalyuk
head	malumma	büja	bondu	biya
nose	gwüngwa	wija	inun	yin
ear	banarre	bibörre	monijaul	jöngi
tongue	kwiamellö	ngadal	dang	önngaba
teeth	dünmburrogi	didö	dirr	ngal
breasts	gwimingoppa	wing	wiing	yingi
back	gumilangwa	bäbbera	dan	deddi
hand	gäuuarrewa	ngallö	ngenyulk	nungur
shoulder	darramindil	delmä	mendum	minmä
testes	gwiungwa	bör	pinguin	morro
foot	gwielgwa	jut	mäl	gumbo
anus	gumolwa	möung	böp	mörrö
water	karawa	wiuk	wak	ouda
fire	gwingwa	win	junge	
smoke	gwaiyingwa	wingal	wendö	dumor
wind	gororua	marröuk	eruk	marrouk
star	mamilemma	murre	ngärwa	bundenyiba
night	damungwa	moradja	bäu yadu	mäuperl
emu	dangorra	ngäurun	ngäurin	allungarinya
crocodile	ngangalabba	wilärre	yingu	warambenn
one	galluwuk	nganjit	yawonyukka	nganji
two	gallitchillik	barkardömmalang	wärrenukka	meidya
three	gallitchillik galluwuk	barkarda nganjit	wöritdawan	meida nganji
come here	ngallak	gau-a	wai yá	gau

*Compare further:—J. L. Stokes: "Discoveries in Australia," 1846, vol. ii., p. 23; T. A. Parkhouse: Trans. Roy. Soc. S.A., 1895, vol. xix., pt. I.; E. M. Curr: "The Australian Race," 1886, vol. i., p. 258 (No. 1, Port Darwin, by Paul Foelsche).

EXPLANATION OF PLATES I. TO XIX.

Plate I.

Larrekiya man, about 28 years of age, with body scars exceptionally well defined, wearing forehead band of kangaroo teeth.

Plate II.

Larrekiya man, about 35 years of age, wearing plume of cockatoo feathers, forehead band, nose-stick, necklace made of threaded segments of grass-stems, armlets, and broad coiled belt of stringybark; the circular scars produced by the firestick along the upper arm and diagonally across the chest are also visible.

Plate III.

Larrekiya woman, about 30 years of age, showing scars made on her back during the mourning ceremony at the death of her husband.

Plate IV.

Kunandra woman, about 23 years of age.

Plate V.

Tree burial. Lifting the corpse to the platform of boughs constructed in the forks of trees.

Plate VI.

Tree grave, near Knuckey's Lagoon.

Plate VII.

Woman in mourning, showing gashed scalp with ashes rubbed in. She is in the act of collecting wood for the camp fire, and is wearing a white forehead band.

Plate VIII.

Natives driving fish, to be trapped in shallow water, Katherine River.

Plate IX.

Native hut.

Plate X.

Fig. 1.—Implements for making fire by the "sawing process."
Fig. 2.—Native making fire by "sawing process."

Plate XI.

Rock drawings, Blunder Bay, Victoria River.

Plate XII.

Rock drawings, Blunder Bay, Victoria River.

Plate XIII.

Rock drawing, monitor, Katherine River.

Plate XIV.

Rock drawing, fish (*Toxotes* sp.), Katherine River.

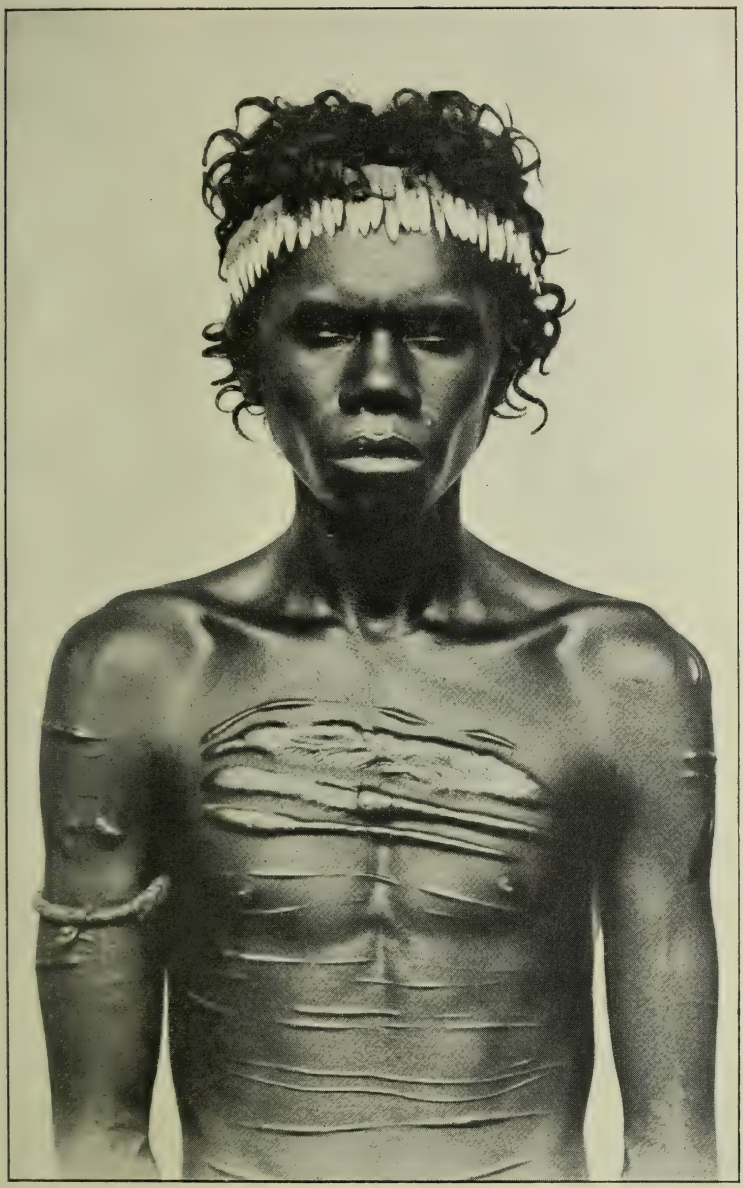
PLATE XV.
Rock drawing, fish (*Therapon* sp.), Katherine River.

PLATE XVI.
Bark drawing, kangaroo, Katherine River.

PLATE XVII.
Bark drawing, emu, Katherine River.

PLATE XVIII.
Bark drawing, bustard, Katherine River.

PLATE XIX.
Bark drawings, east of Port Darwin.



LARREKIYA YOUTH.

Hussey & Gillingham, Printers, Adelaide.

LARREKIYA MAN.

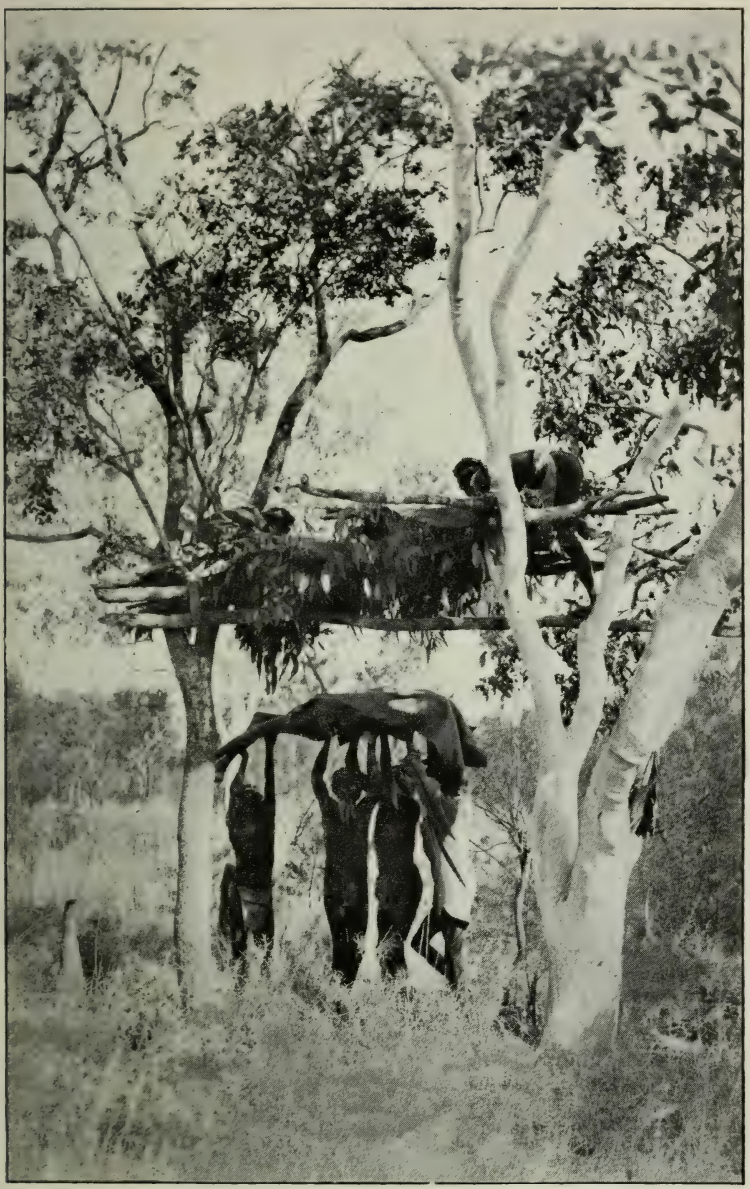
Hussey & Gillingham, Printers, Adelaide.

LARREKIYA WIDOW.

Hussey & Gillingham, Printers, Adelaide.

KUNANDRA WOMAN.

Hussey & Gillingham, Printers, Adelaide.



TREE-BURIAL.

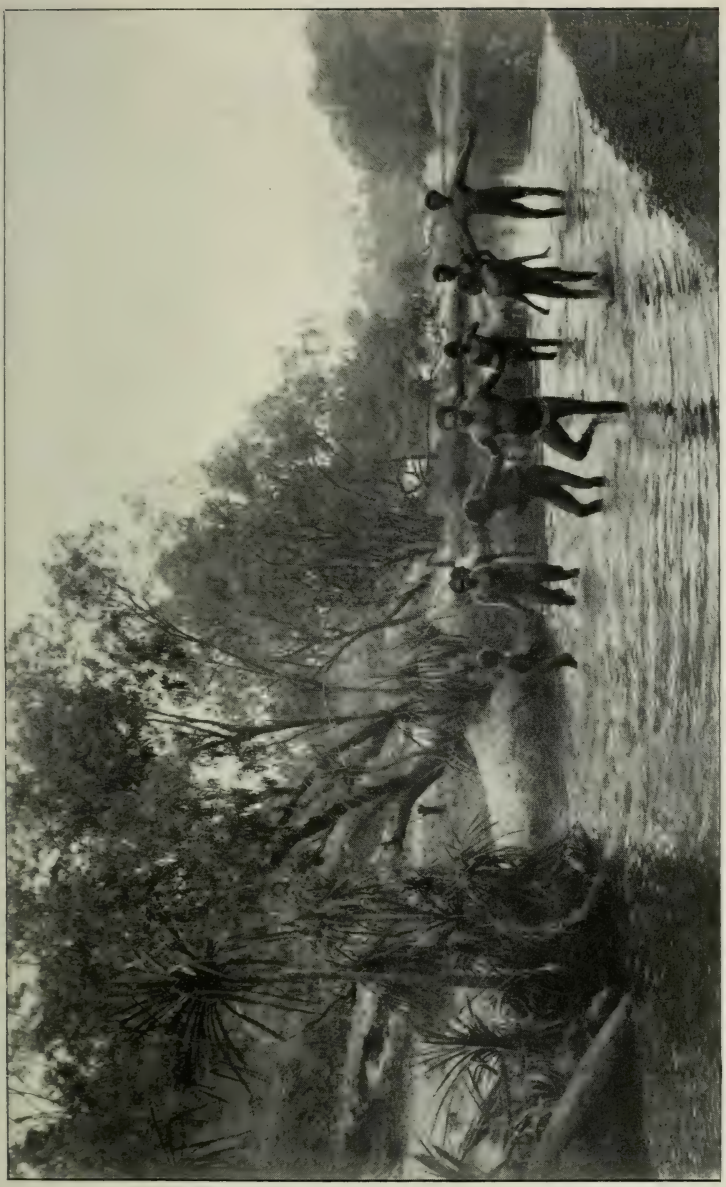
Hussey & Gillingham, Printers, Adelaide.

BURIAL-PLATFORM, NEAR KNUCKEY'S LAGOON.

Hussey & Gillingham, Printers, Adelaide.

WOMAN IN MOURNING.

Hussey & Gillingham, Printers, Adelaide.



DRIVING FISH TO TRAP, KATHERINE RIVER.

Hussey & Gillingham, Printers, Adelaide.

NATIVE HUT.

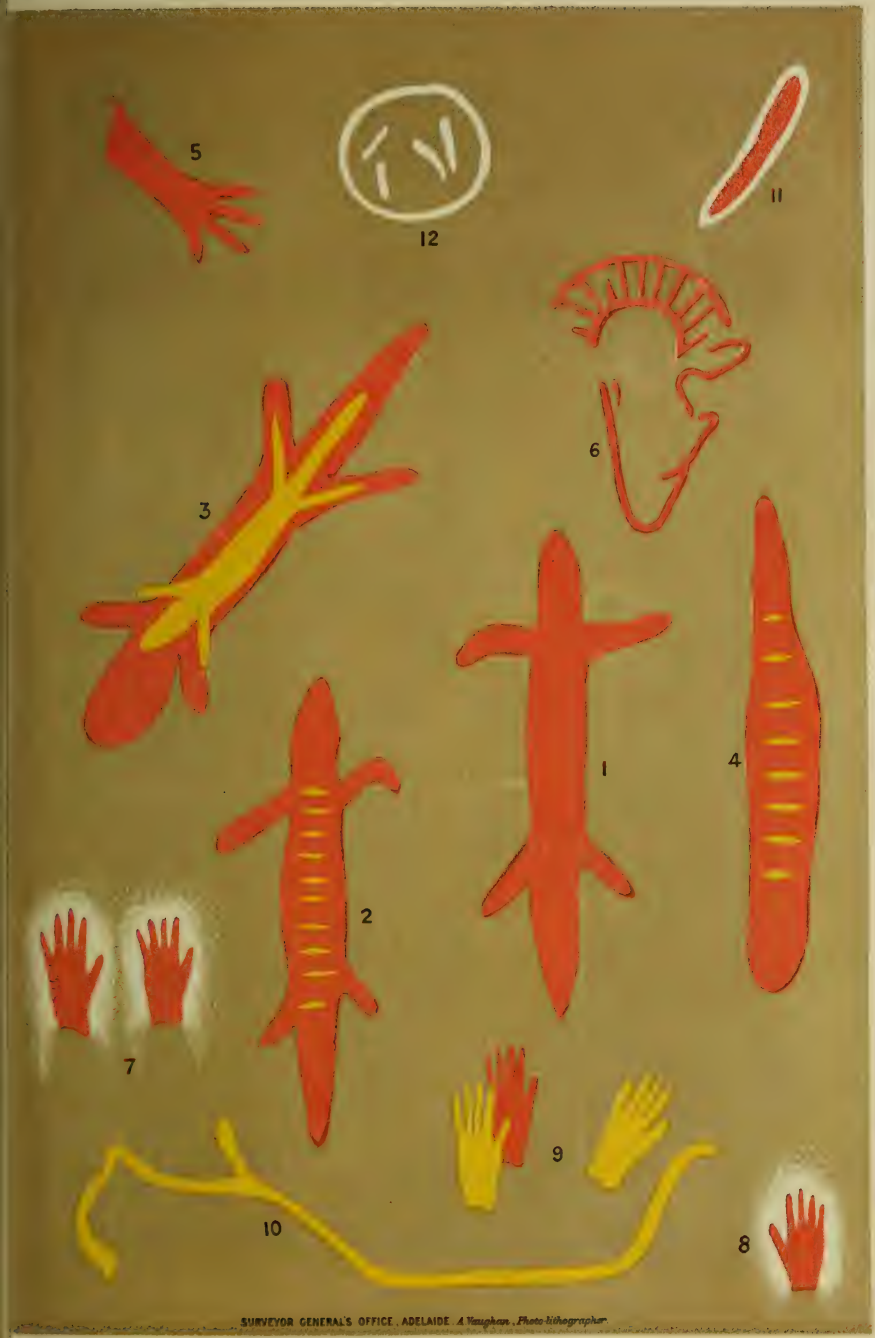
Hussey & Gillingham, Printers, Adelaide.

FIG. 1.
IMPLEMENTS FOR MAKING FIRE BY "SAWING PROCESS."

FIG. 2.
FIRE-MAKING BY "SAWING PROCESS."

Hussey & Gillingham, Printers, Adelaide.

ROCK DRAWINGS, BLUNDER BAY, VICTORIA RIVER.



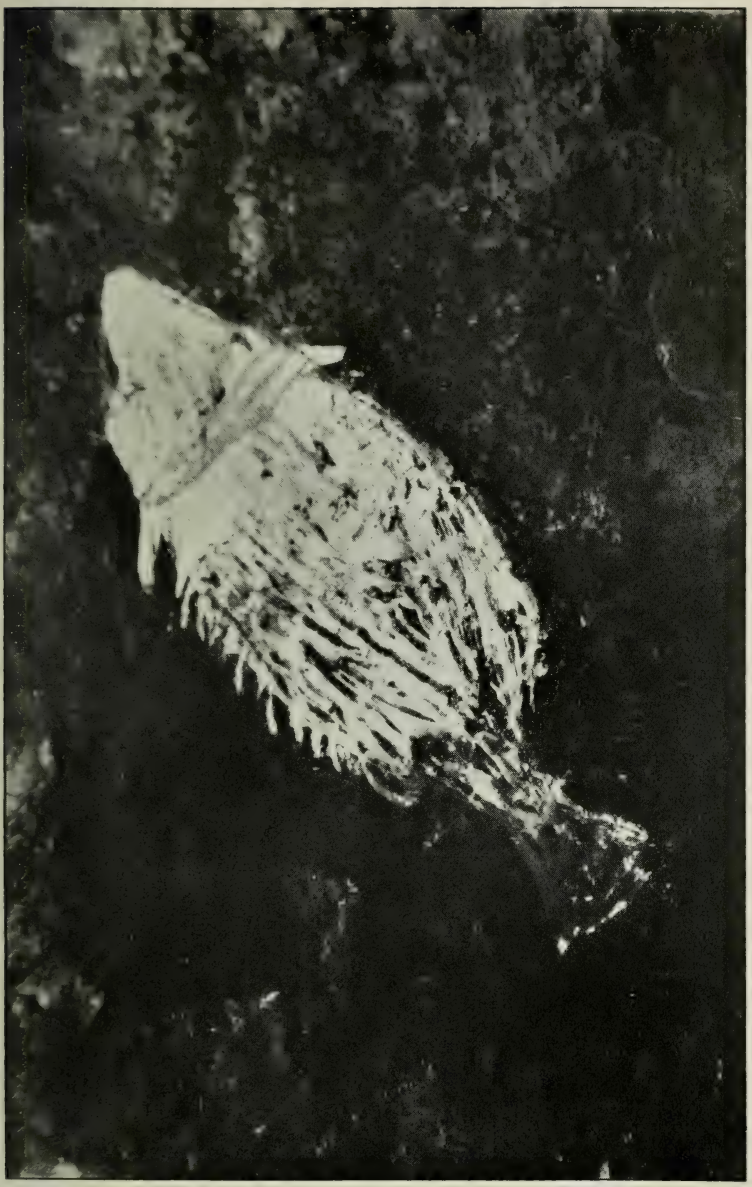
ROCK DRAWINGS, BLUNDER BAY, VICTORIA RIVER.

ROCK-DRAWING, KATHERINE RIVER (MONITOR).

Hussey & Gillingham, Printers, Adelaide.

ROCK-DRAWING, KATHERINE RIVER (*TONOTES* Sp.).

Hussey & Gillingham, Printers, Adelaide.

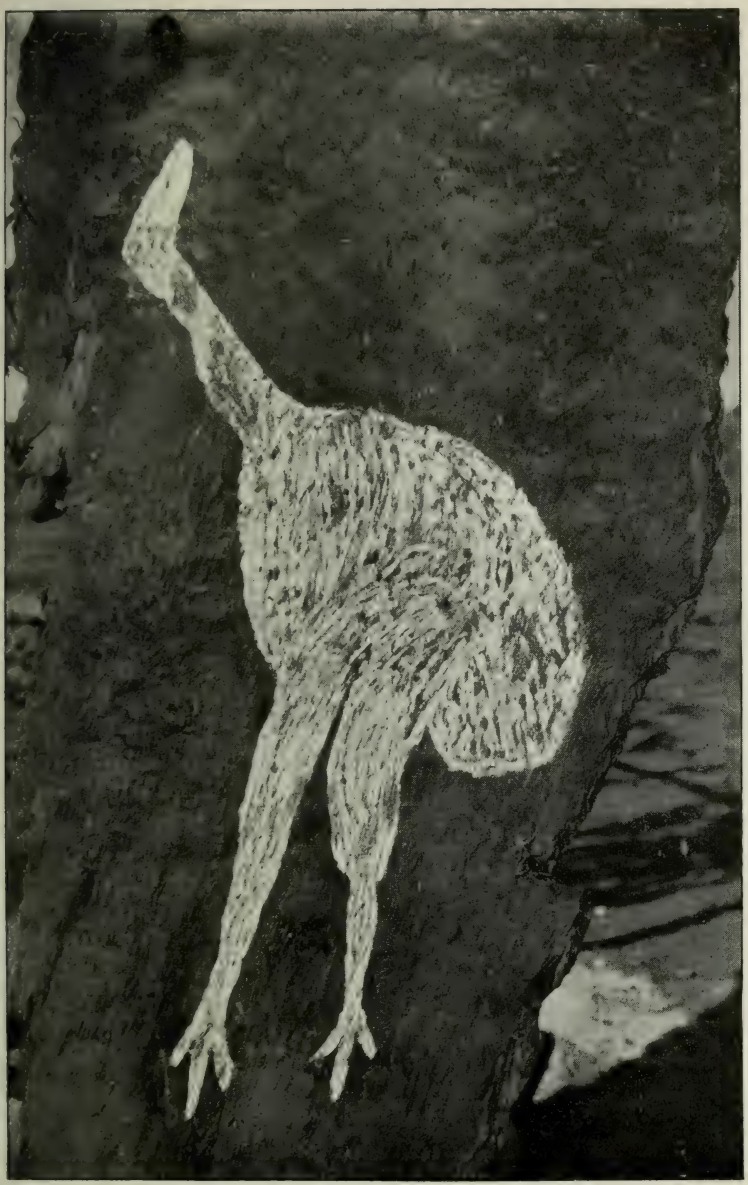


ROCK-DRAWING, KATHERINE RIVER (*THERAPON* Sp.).

Hussey & Gillingham, Printers, Adelaide.

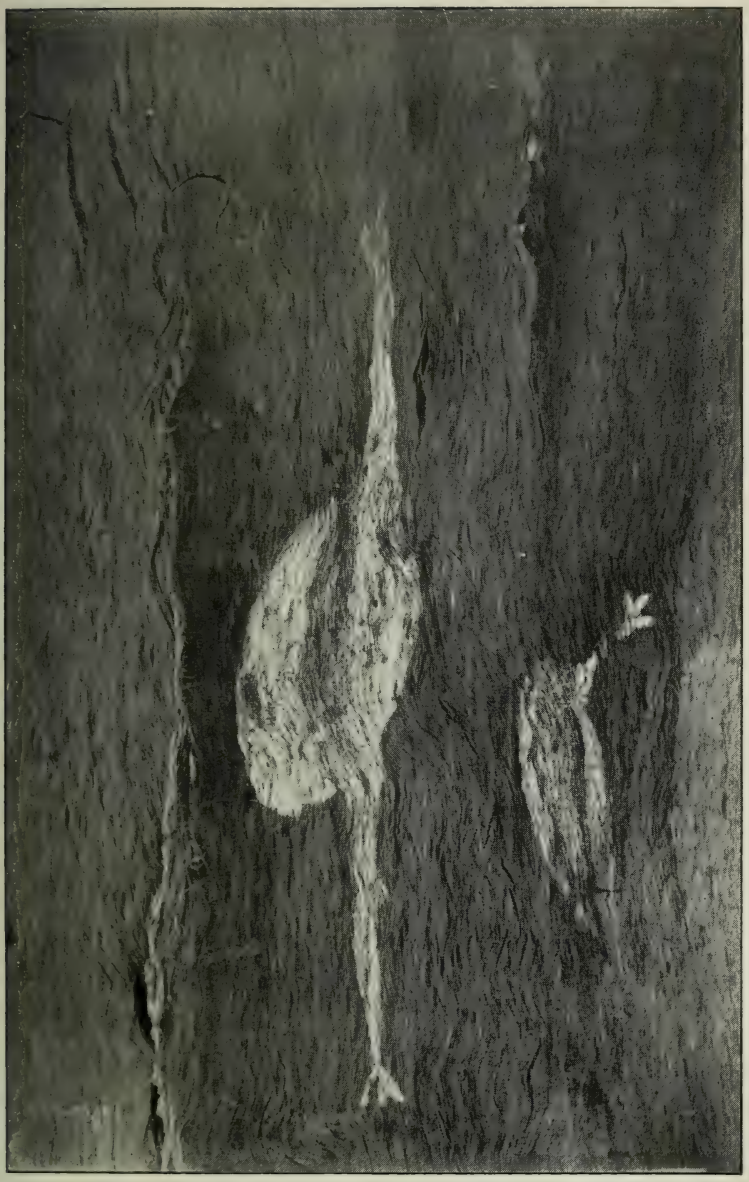
BARK-DRAWING, KATHERINE RIVER (KANGAROO).

Hussey & Gillingham, Printers, Adelaide.



BARK-DRAWING, KATHERINE RIVER (EMU).

Hussey & Gillingham, Printers, Adelaide.



BARK-DRAWING, KATHERINE RIVER (BUSTARD).

Hussey & Gillingham, Printers, Adelaide.

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DRAWINGS ON BARK FROM EAST OF PORT DARWIN.

A New Microtis.

By R. S. Rogers, M.A., M.D.

[Read November 6, 1906.]

Plate XX., Fig. 1.

Although the genus *Microtis* is widely distributed throughout Australia, it is represented by only a few species. In this and the eastern States three have been recorded, *viz.*, *M. porrifolia*, *M. parviflora*, and *M. atrata*. Of these, the second has been regarded by Baron von Müeller and others merely as a variety of the first. *M. porrifolia* is found in all the States and in New Zealand.

M. parviflora is a rarer form, but occurs in all the eastern States, though not in South Australia.

Both these species were discovered by Robert Brown in 1802.

M. atrata is a minute species, rather sparsely distributed in this State and in Victoria. It was named by Lindley in 1839.

The discovery of a totally new species in this State is therefore of more than usual interest. I found this plant on November 2, growing in a swamp at Myponga, a place situated about thirty-seven miles south of Adelaide. It was not rare in this locality, and I was able to collect a large number of specimens without difficulty.

Because of its round tongue, I have named it "*Microtis orbicularis*."

Microtis orbicularis, *nov. sp.*

The plant varies from about 7 to 12 inches in height.

Its *stem* is rather slender, with a marked and characteristic angulation, or shoulder, where it emerges from the sheath. This divergence from the vertical often makes an angle of 45 degrees, and is present in over a hundred specimens which I have preserved. There seems to be a marked uniformity, too, in the distance between the fistula in the leaf and the beginning of the inflorescence. This is about half-an-inch.

The *leaf* rarely reaches more than halfway up the spike

The *spike* varies in my specimens from $\frac{3}{4}$ in. to $3\frac{1}{4}$ in. It presents a generally flatter appearance than in "*M. porrifolia*," and the flowers are not so crowded as in that species, varying from 5 in the shortest specimens to 30 in the longest.

The *flowers* are minute, sessile, and subtended by a wide, obtuse, clasping bract, which covers in the greater portion of

the antero-lateral aspect of the ovary. The dorsal *sepal* is obtuse and galeate; the lateral ones are flat and linear, lying behind the labellum, which completely hides them in a front view of the flower. *Lateral petals* are transverse, fairly wide, shorter than the labellum, and slightly re-curved.

The *labellum* is orbicular, with entire margin. There is no appearance of crenulation in fresh specimens. Upper surface is somewhat concave.

The *column* is very minute, with distinct linear auricles. The rostellum is protuberant, and shows as a dark dot below the galea of the dorsal sepal. The anther-case is galeate and bi-loculate, the caudicle is long.

Two varieties were observed, one green, and the other a reddish-brown, the colouration apparently not depending on the age of the plant.

It will be seen that it differs from all Australian species of *Microtis* in the shape of the labellum; and from all but *atrata* and *pulchella* in the absence of recurved lateral sepals. From *atrata*, which is the most minute species recorded, it further differs in point of size, colour (the colour of *atrata* being very constant in this State—a yellowish-green), and in the fact that the lateral sepals are not hidden by the labellum in this pigmy form. *M. pulchella* has broad lateral sepals, and a contraction in the middle of its oblong labellum, which readily distinguish it from the new species.

On account of the inadequate descriptions of *M. parviflora*, this is indeed the only form with which it is likely to be confused. Here, however, the lateral sepals are recurved and not hidden by the labellum; the labellum is rectangular, generally with crenulate margins; the flowers are not sessile, and the large clasping bract is absent. *M. orbicularis* further differs from this, and, indeed, all eastern species, in the *marked angulation* in the upper part of the stem.

Description of Plate XX., Fig. 1.

A. Front view, showing:—*d.s.*, dorsal sepal; *l.p.*, lateral petals; *l.*, labellum; *b.*, bract (shown rather large in this figure); *o.*, ovary.

B. Side view, showing, in addition to the above:—*l.s.*, lateral sepals (hidden by labellum in *A*).

Fig. 1.

Fig. 2.

Hussey & Gillingham, Printers, Adelaide.

THE PHOSPHATE MINERALS FROM ELDER ROCK.

By D. MAWSON, B.E., B.Sc., AND W. T. COOKE, D.Sc.

[Read November 6, 1906.]

PLATE XX., FIG. 2.

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I. INTRODUCTION.

Elder Rock is situated ten miles south-east of Paratoo Railway Siding, and, roughly, 160 miles north of Adelaide, on the Broken Hill line.

The occurrence of nitrogenous phosphatic rock from this locality was announced by Mr. J. G. O. Tepper at the last November meeting of this Society. Specimens of a red, porous, ochreous rock, said to contain quantities of nitrogen, ammonia, and phosphoric acid, were exhibited.

Shortly afterwards several smaller occurrences were reported, distributed at intervals in an east-north-easterly direction from the original discovery.

The "Elder Rock Nitrates Development Company" proceeded to exploit the deposit, but soon proved beyond doubt its limited nature, and ceased operations.

II. LOCAL GEOLOGICAL FEATURES.

The route from Paratoo Railway Siding lies across two ranges of hills with flat land intervening. The first of these is met one mile out, where the road follows a deeply eroded creek-bed, cutting across the strike of the range, and exposing strata of a familiar character. In conversation with Mr. W. Howchin, who had already visited the locality, these rocks were described as belonging to the middle division of the South Australian Cambrian series; according to the same authority they are described as "corresponding to the Tapley's Hill slates and impure siliceous limestones and true limestones of the Brighton series, with a general strike to the

north-east and a dip south-east at about 35°." The strata flatten out further to the south-east, where an almost horizontal impure limestone is conspicuous, leading up to the Grampus Range, which latter is crossed within a mile or two of the fertilizer claims.

The Grampus Range is a jagged tent-hill ridge of quartzite, flanked on either side by softer and more readily denuding slaty strata. The main quartzite bed is about 25 ft. thick (striking about N. 74° E., and dipping 69° to the north). It can be traced for some fifteen miles on either side boldly outcropping across the plains in an almost linear direction. At the trigonometrical station on top of Grampus Hill, a remarkable view is unfolded. From that high point the dreary prospect of barren saltbush plains is relieved, and the effect of arid weathering on the rocky pedestal itself correspondingly accentuated.

On the south side of Grampus Creek is a broad belt of limestone, apparently part of the same series. At several places examined this limestone is much metamorphosed by silication, and is intersected by manganiferous and micaceous-iron lode formations. It is in close association with this belt that the hardened breccia, forming Elder Rock and the other outcrops bearing the fertilizer further to the north-east, occurs.

Owing to its soft character also, denudation has here progressed rapidly and fostered the main drainage lines of the district, developing Grampus Creek and a wide belt of low—at one time, when the rainfall was heavier, evidently swampy—land in its course.

III. Elder Rock.

Elder Rock rises from this low-lying level area with almost shear sides 30 ft. in height (see pl. xx., fig. 2). When viewed from a distance it reminds one of a ruined fortress. Its horizontal dimensions are, roughly, 25 yards by 30 yards. A coarse breccia composes a large part of its mass, and is usually dark-coloured, due to the presence of much iron, as magnetite and hæmatite; other parts are formed of ferruginous quartzite. Case-hardening, due to arid conditions, has produced a superficial weather-resisting shell with much softer rock a few feet within.

On top, in depressed areas, several inches thick of hard yellowish phosphate was discovered. It is likely that at one time this material was more abundant, as traces of it appear over all the top of the rock, and at several places down the sides where showers of rain have transported it in solution. All cracks and fissures were found occupied by the same substance.

On the west side an adit has been driven in towards the centre of the rock 30 ft.; and in the floor of a chamber, excavated 10 ft. in from the mouth, a winze has been sunk a distance of 16 ft., and again from the bottom of this a drive put in about 18 ft. to the west.

Near the mouth of the adit, some 30 ft. below the top of the rock, a fissure was observed, lined with a phosphate similar to that on top of the rock. Within the rock, in chimney-like pipes, a foot or more in diameter, and closed at either end, a dark chocolate-coloured substance was observed in crustified layers; this substance chiefly consists of ferric oxide, with abundance of ammonia and nitrate, and a small quantity of phosphate. In the vicinity of these chimneys the whole body of the rock, which is a porous, ferruginous sandstone, is charged with these fertilizers. More remote from such channels, the valuable contents diminish in amount until traces only can be detected in the rock. Nitrogenous rock was met in the lower drive, indicating a considerable vertical extension of impregnation.

IV. Origin of the Epigenetic Fertilizer Contents.

A careful consideration of the nature of the occurrence leaves no other conceivable explanation of genesis than that this peculiar combination of substances originated from a guano deposit. We surmise that a considerable accumulation of bird-droppings have, in not remote times, been deposited on Elder Rock, and since largely removed by rain water. As already remarked, there is evidence of one-time swampy conditions in the vicinity, along the course of Grampus Creek, favouring the possibility of abundant bird life. In any case, its prominence determines it a natural resting-place for flying creatures, and so present conditions, even, are favourable to accumulations of bird guano. Confirmation of this latter argument, as well as the bird-derived origin of the phosphate, is had in a similar, though smaller, deposit, encrusting the summit of a lofty quartzite peak, about one mile west of the Ajax Mine, near Beltana. At this latter locality, when visited last January, recent bird-droppings were found passing into material identical with that at Elder Rock; moreover, a large eagle took flight from the spot as we approached.

The residuary yellow phosphate on top of Elder Rock has resulted by various chemical changes effected in the guano; the more soluble compounds having passed away in solution and the comparatively insoluble iron and aluminium phosphates remaining. This latter owes much, in a genetic sense, to arid climatic conditions. Though not a simple mine-

ral compound, we will, for the sake of brevity, refer to this residuary phosphate as *paratooite*. No similar substance has, to our knowledge, been previously recorded from South Australia, though it is likely distributed in scattered occurrences where the physiographic conditions are similar.

The *paratooite* from near Beltana encrusts quartzite and contains only small quantities of iron. That from Elder Rock contains abundance of iron, which has evidently been derived by chemical changes from the underlying ferruginous breccia.

Part of the soluble salts in the guano has been lost by torrential rains; much appears to have sunk deep into the porous rock below, and is specially concentrated, as already remarked, on the walls of the crevices and chimneys.

Samples of rock taken at intervals in depth below the *paratooite* showed, when tested qualitatively, a regular decrease in phosphate contents and gradually increasing ammonia and nitrate. Three chief zones were recognized: At the surface, *paratooite* containing no appreciable amount of ammonia or nitrate; below, the rock was found charged with phosphates and ammonia, and but mere traces of nitrate; at greater depths, for example, in the lower drive, 46 ft. below the top of the rock, ammonia and nitrate were found in the rock, and only traces of phosphate.

The ammonia content of the intermediate zone is regarded as existing chiefly in the form of ammonium phosphate (stercorite molecule). In the lowest zone it is likely combined as ammonium nitrate. The possibility of the presence of more than inappreciable amounts of the nitrates of sodium and potassium is eliminated by the absence of these elements in notable quantities, as proved by an analysis of a bulk sample of the rock. The better quality of this impregnated rock bulked about 5 per cent. of ammonium nitrate.

The chimneys met with in excavating operations had no connection with the exterior, and as no trace of bat guano or bones was found, the main responsibility is thought to lie with birds.

V. Chemical Composition and Physical Characters of Paratooite.

The substances examined are mixtures of several phosphates, with much mechanically-admixed sandy matter. A petrological examination revealed two main distinct mineral forms in the *paratooite*, readily distinguished by being isotropic and anisotropic respectively.

Two samples were selected for analysis. One of these chiefly composed of the isotropic variety, the other mainly

anisotropic phosphate. The former of these, a light yellow encrusting form, returned the following composition :—

	Bulk Analysis.	Re-calculated (less impurity).
SiO_2 (sand impurity) ...	17·30	—
Al_2O_3 ...	17·12	20·70
Fe_2O_3 ...	6·78	8·20
CaO	2·06	2·49
MgO	0·92	1·11
P_2O_5	35·22	42·59
H_2O (loss at 120°)...	16·94	20·49
Ignition	2·65	3·20
By diff., chiefly Alkalies ...	1·01	1·22
	100·00	100·00

The second column is a readjusted statement of the analysis after subtracting the silica present as sandy impurity.

On calculation, this result is found not to represent any definite molecular combination, nor was it expected that any such could be deduced after the foregoing petrological observations. It is evidently a mixture of several substances, whose exact nature cannot be determined.

The second variety occurs in depressions on the surface of the rock, and masses 20 cms. thick were obtained. It is found as an aggregation of tiny globules about 2 mms. diameter, appearing yellowish-brown on broken surfaces. Fracture, smooth. Hardness, 5·5. Lustre, dull. In sections under the microscope the spheres are seen to be composed of aggregated doubly-refracting matter of a yellowish-brown colour. An indistinct radial arrangement is observable especially towards the outer margin, where it is also usually of a somewhat lighter tint. A little foreign sandy matter is present. Double refraction, probably about 0·023. Refractive index, much above quartz.

	Bulk Analysis.	Re-calculated (less impurity).
SiO_2 (sand as impurity) ...	36·72	—
Al_2O_3	7·06	11·19
Fe_2O_3	24·25	38·43
CaO	2·32	3·68
P_2O_5	17·37	27·53
H_2O (loss at 120°)... ...	10·36	16·41
Ignition	1·74	2·76
	99·82	100·00

The second column is a re-statement of the analysis, after deducting 36·72 per cent. of sand.

Again, in this case, also, no definite molecular composition meeting both the petrological and chemical requirements can be assigned.

The salient fact demonstrated by the analyses is that, in the case of the first mineral, the light yellow encrusting isotropic phosphate is a mineral of the evansite type; the other variety, found in globular aggregates, and appearing anisotropic, is distinctly of the beraunite type, perhaps closely related to globosite.

VI. Summary.

1. Elder Rock is a prominent, abrupt mass, standing in a level plain in the arid northern districts of South Australia.

2. A hard yellow phosphate encrusting the top of the rock is the remnant and more insoluble part of a larger deposit of guano, chiefly bird-derived.

3. The soluble salts of the guano have, to some extent, saturated the rock for a depth below; in a favourable spot this impregnation has been effective for at least 46 feet in the vertical. These compounds are chiefly nitrates of ammonia, with some fixed alkali and phosphate. The more soluble compounds have percolated to greater depths.

4. The hard yellow phosphate on top of the rock is a mixture of minerals, chiefly iron and aluminium phosphates, and has no definite composition; it is, however, here referred to as *paratooite*. Two widely-divergent types are described, the commoner near to *evansite*, and a scarcer globular phosphate related to *beraunite*.

5. *Paratooite* probably has a wide distribution, as small scattered occurrences in the arid northern parts of South Australia.

So far as we are aware, no similar phosphate has ever previously been described from Australia.

DESCRIPTION OF PLATE XX., FIGURE 2.

Elder Rock, seen from the east: barren saltbush plains in the foreground.

Geological Features of Part of Eyre Peninsula.

By D. Mawson, B.E., B.Sc.

[Read November 6, 1906.]

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I. Introduction.

The following remarks on the geological features of southern Eyre Peninsula are but cursory, the data having been collected during several short visits only. The publication of such hasty observations, however, seems amply justified, as no geological reports,* so far as I can ascertain have yet been furnished on this area.

The field examination was conducted from two centres, Port Lincoln and Tumby Bay.

II. Physiography.

The topographical features in the neighbourhood of Port Lincoln tend to a north-and-south development, conforming to the trend of the strata. Hilly country, of varying width, skirts the Gulf shores from Port Lincoln to Lipson's Cove on the north, a distance of forty miles; at some distance to the south, also, precipitous sea cliffs are developed.

It is the Port Lincoln to Lipson Cove belt that has come under immediate observation. The hills in this stretch of country reach a fairly uniform height of 800 to 1,000 feet. Beyond the coast range, two miles west of Port Lincoln, the country falls steeply into a low swampy area, running parallel with the high ground. Pinch Swamp occupies the most depressed portion of this belt, which extends towards the Southern Ocean.

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* A few odd statements referring to this region may be culled from the reports of the Mines Department of South Australia, but they do not pretend to geological detail.

West, again, level, seemingly barren country, supporting sheaoak, yacca, and heath, forms a peneplain, elevated several hundred feet, and extending far towards Coffin Bay. In that direction, the Marble Ranges stand out in the distance as solitary imposing ridges; only minor undulations modify the intervening expanse.

On the Gulf side, commencing some two miles north of Port Lincoln, a narrow aggraded peneplain extends northwards at an elevation of some 20 feet above the sea. As it proceeds up the coast, it broadens out considerably to a maximum width of 10 miles at Red Cliff, above Louth Bay. It also varies considerably in elevation. In part, especially where it is broadest, this surface owes its planation to degradation. Some of the cliff exposures in the aggraded areas show mottled clay-beds, quite similar to those classed as freshwater Miocene in the vicinity of Adelaide. This stage of peneplanation is therefore to be correlated with the mid-level plane so strongly marked in the hills near Adelaide.

The uniformly level surfaces of Tumby Island and the islands of the Banks Group in Spencer Gulf appear to be topographically continuous with this peneplain, and indicate a former continuity in that direction. Inland from Tumby Bay, where the hills commence, traces of a peneplain can be noted standing at higher elevations, abruptly terminated on the eastern side by the lower coast plains. West, for about 15 miles, this high-level planation extends, though much warped and dislocated.

III. Geological Features.

(a) Recent.—A soft recent limestone, a few inches to many feet in thickness, occurs as a covering on the older rocks over a wide area in the Port Lincoln district; especially is this formation more abundant towards the south. It is found thickest on lower ground, but patches occur high up on the flanks of Winter's Hill, elevated at least 600 feet. In its unaltered state it is composed of foraminiferal tests and comminuted shell fragments; at other times it is formed of an exceedingly fine calcareous powder, resembling chalk, though sufficiently hard to be of some use as a building stone. Travertinization has developed an upper harder crust, as much as several inches in thickness, and in places downward percolating waters have formed travertine tubes, with a general megascopic appearance, not unlike some species of Lithothamnion.

A similar limestone formation has been described by various authors from Southern Yorke Peninsula and other parts of the State. According to Mr. Howchin, who is

well acquainted with this material, it is of wind-blown origin, and of recent age.

(b) Miocene (?).—The more conspicuous peneplains described are probably of Micocene age, as the aggraded areas are formed of fresh-water sediments, similar to those better known in the vicinity of Adelaide. Pebble beds are frequently interbedded with the clays, indicating proximity of origin. On account of their soft nature these beds are much cut into by the erosive action of the sea.

(c) The Pre-Cambrian Complex.—With the exception of the minor developments already described, all the rock exposures known to us are probably of Pre-Cambrian age. The data leading to this conclusion rests on petrological and lithological grounds, as palæontological evidence, except for negative information, is entirely wanting. The resemblance which the Port Lincoln series of rocks bears to that classed as Pre-Cambrian in Southern Yorke Peninsula is the main support for this decision. In addition, the absence of any beds of the recognized Cambrian series of the Mount Lofty Ranges, and the extreme metamorphism displayed, aids in this same conclusion.

At Port Lincoln the strata trend uniformly in an almost north and south direction, with a tendency to east of north.

At Tumby Bay the rocks are chiefly meta-sedimentary, and preserve a uniform N. 55° E. direction. There is a distinct possibility, therefore, that these are two separate series, the Port Lincoln rock being referable to an older period. A careful survey of the intervening country will alone settle this point.

At Port Lincoln a great series of schistose rocks, chiefly gneisses, is well exposed at Point Kirton, where quarrying operations are in progress for the railway jetty under construction. Here pure white, coarse-grained quartz-felspar gneiss passes into a typical augen variety, with biotite developed along the lines of crush. In places it is intricately folded. Dark-grey basic bands, of fine-grained amphibole granulite, sometimes many feet in thickness, run parallel with the gneiss, sometimes isolated in the midst of the latter. Occasional coarse acid pegmatite veins can be traced passing obliquely across the foliation. One of the most notable features in the vicinity is the occurrence of a biotite-bearing pilotaxitic dolerite dyke, about 30 feet wide, running with the series. For the most part this rock is entirely fresh, though along certain cracks uralitization was noted to have commenced. No clue to its age is forthcoming. It cannot be very ancient, certainly not comparable in this respect with the intruded rocks.

Westward of the township, further developments of a similar gneiss, with occasional patches of true granite outcrop at intervals along the old Lake Wangary Road to its summit; at this point an interesting series of rocks, with features more strongly suggestive of a meta-sedimentary origin than any previously noted, is met with. Fine grained felspar-actinolite, mica-felspar-quartz, and epidote-quartz schists alternate in narrow bands with each other. Amongst these is a beautiful actinolite-felspar-quartz schist, in which the actinolite has taken up a radial arrangement identical in appearance with specimens collected at Rocky Gully, near Murray Bridge. Further gneissic rocks, with structures strongly suggestive of a sedimentary origin, outcrop on the west side of Winter Hill. An isolated bed of fine-grained quartz-felspar schist was noted outcropping on the far side of Pinch Swamp.

At Tumby Bay the most attractive feature of the old rocks is a wonderful development of marble in all stages of silication. This belt of rock, though highly metamorphosed, is readily distinguished, and can be followed from near Lipson Cove, in a south-west direction, past the Port Lincoln Copper Mine, and no doubt extends far in the direction of the Marble Range. Magnesian minerals are largely developed in this belt, serpentine, asbestic, talc, and magnesite being fairly abundant. In places, silication has advanced so far as to produce a nearly pure wollastonite rock.

Bordering on this metamorphic-marble belt are thick strata of highly crushed rock, in which are abundant pseudo pebbles of granulated quartz and felspar; these are embedded in a schist base of fine particles of the same materials, with abundant highly pleochroic (light yellow to deep red) mica and garnets. Some beds in this zone are so exclusively composed of garnets as to assume the character of garnet rock; specially good examples of such are met with a few yards west of both the Port Lincoln Copper Lode and the Burrawing Lode.

At the Port Lincoln Mine, which is on the south-east side of the marble belt, the strata dips steeply to the north-west, whereas an opposite dip was recorded further to the north-west. This fact, taken in conjunction with a sharp syncline observed in certain overlying quartz-felspar schists, possibly indicates a synclinal trough. On either side of this belt, trending in a parallel direction, are rocks of a more igneous character.

Southward, towards Yalluna, is a broad series of gneissic rocks, very beautifully lined, darker areas composed of granular orthoclase, quartz, magnetite and much sea-green

amphibole, alternating with colourless bands of quartz and felspar, the latter mineral usually arranged as corroded ovoid units. Thus is formed a laminated grey and white rock, and various stages are observable, in which either of the bands become predominantly developed. Though meta-igneous in general appearance, there are grounds for ascribing a possible meta-sedimentary origin for at least a portion of this series. As far as a mile across the strike beyond this are garnet-mica-quartz-felspar schists passing further south into grey gneiss, composed of granulated quartz and felspar, with a little biotite only. Coarse pegmatite dykes are abundant, often carrying tourmaline and hæmatite.

North-west of the metamorphosed marble belt, in the vicinity of Wadella Springs, much pegmatitic tourmaline-bearing granite, forms conspicuous dykes amongst schists and granulites. Eight miles further west, near Chinmina and Cockaleechie, outcrops of quartz-felspar-schist and gneissic granite types were observed.

IV. Economic Mineral Resources.

The character of the country, and the prospects so far brought to light, augur much for the possibilities of economic mining in Eyre Peninsula.

Copper will, no doubt, always stand far ahead of other mineral products. It is interesting to note that about one-sixth the world's production of this metal is won in the Lake Superior regions from rocks of approximately the same age as the Tumby Bay series.

The main lode of the Port Lincoln Copper Mine is the type that should be further prospected for along the syncline of metamorphosed marble. The ore in this formation is a good quality copper pyrites, introduced as a metasomatic replacement of the limestone, which, in places, is mineralized for a width of 20 feet along the strike from the underlay side. A quantity of quartz occurs with the ore. Iron pyrites is developed in slaty bands.

South of the main ore-belt copper-bearing fissure veins cross the schists, and, though always narrow and irregular, have yielded a quantity of ore.

Very little mining has been done for other metalliferous minerals.

Much *iron ore*, chiefly as a surface concentration from iron-bearing schists, is scattered through the district generally, forming prominent hills, a usual feature in the weathering of archæan schists. Such ores are both hæmatite and limonite, and often contain a notable proportion of manganese; occasionally, the percentage of this latter element is

so preponderant as to constitute a manganese ore. These ironstone outcrops may, in some cases, harbour copper ore at a depth; especially is this likely in proximity to the marble belt.

Graphite.—A belt of gritty and argillaceous meta-sedimentary strata, several hundred yards in width, and situated about a mile west of the Port Lincoln Mine, is charged with graphite to such an extent as to offer possibilities for development. Other outcrops of graphite-bearing rocks are reported from the district.

Clay.—A wonderful development of remarkably pure kaolin occurs about 15 miles west of Tumby Bay, between Chinmina Creek and Cockaleechie Creek.

Felspar.—A massive pegmatite dyke, with large blocks of orthoclase felspar, cuts the marble series in the Mine Creek, near the Port Lincoln Mine. This is an example of many similar felspar-bearing formations of economic value developed in the district.

Magnesium Minerals.—Chrysotile (asbestic), talc, and magnesite are abundantly developed in the marble belt, and cannot long remain unexploited.

The Wadella Springs and Associated Bog-Iron Ore Deposit.

By D. Mawson, B.E., B.Sc.

[Read November 6, 1906.]

The Wadella Springs are located on Eyre Peninsula, about seven miles west-north-west of Tumby Bay. Their present aspect is more of the nature of a soakage, water oozing to the surface over an area several hundred yards in length. Coarse reedy grass grows along the creek-bed, draining the boggy ground, and directs attention to the presence of moisture.

The rocks in the vicinity are highly metamorphic schists and gneisses, regarded as of Pre-Cambrian age, intruded by numerous pegmatitic granite dykes. In close proximity, also, is a large body of iron ore, forming a flattish-topped knoll, whose upper surface is elevated about 700 feet above sea level. The creek draining the springs has cut away the southern end of the deposit in its work of channel development. The limonite composing the ore-body is exceptionally pure, and different in character from that usually found composing ironstone outcrops in South Australia. A syndicate that one time held the property sank several shafts, and proved the body to be comparatively shallow. The excavations also showed it to be composed in the main of large masses of solid limonite, breaking with a varnish-like fracture, set in a matrix of an impure earthy variety; this latter increases in relative bulk towards the base of the deposit, depreciating its value.

An approximate estimate of the thickness of the mass is some 30 feet towards the centre, gradually decreasing in saucer fashion towards the margin. The superficial area is, roughly, a couple of acres.

The springs are situated about 50 feet below the top of this ironstone rise, on its western and southern borders. When making geological investigations in the district, my interest was enlisted by Mr. G. Carr, the farmer in possession. This gentleman assured me that he had a petroleum spring on his property. He further described it as not any ordinary type, but one which is in the habit of changing its affluent liquid to milk in wet weather, and, at all times, having a powerful corrosive action on rock fragments placed in its waters. With this air of mystery, no further inducement was necessary for me to arrange a visit to the enchanted

spot. At that time the weather was dry, and the spring water only gently oozed from the ground, trickling away with an irridescent oil-like scum. Tiny colourless crystals were observed deposited on sticks and other rubbish in its course. These latter proved to be gypsum; the irridescent scum, a hydrated oxide of iron. The water was found to be charged with sulphates, chiefly of calcium.

About six weeks later, it being wet weather, a second visit was made. The waters were, on this occasion, observed flowing away white and milky. The milk-like appearance was found to be due to an abundant fine white precipitate of calcium sulphate.

Putting these observed facts together, it is evident that the Wadella Springs are deep-seated in their origin, and mineralized with abundant sulphate contents. Iron sulphate is a notable constituent, no doubt derived from the oxydation of pyritous bodies below. The iron in such chalybeate waters is readily thrown out as hydrated oxide by calcium carbonate, or organically derived substances, such as ammonium humate, occurring in surface waters. Under ordinary conditions the process is slow, and the calcium sulphate formed crystallizes out as gypsum; in wet weather, when surface water, saturated with calcium carbonate, flowing over the ground, meets the spring water, an abundant, fine white precipitate of calcium sulphate (gypsum) takes place, producing the milky appearance.

It is further evident that the bog-iron ore deposit in proximity has originated from these spring waters. The fact that the present outlet of the springs is about 50 feet below the top of the ironstone deposit indicates the lapse of a considerable period of time since the maximum phase of activity when notable ore-deposition was in progress. The ore body is very similar to the scattered limonite deposits in the Mittagong district of New South Wales.

The Wadella Springs are of further interest, as affording an illustration of how gypsum deposits may originate, thereby aiding to explain the vast accumulations and widespread distribution of the latter mineral in self-contained inland drainage basins of South Australia, where abundant calcareous and pyritic schists are exposed for denudation.

A Comparison of Some Forms of Electric Radiation.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics, the University of Adelaide.

[Read May 7, 1907.]

We are now aware of the existence of a number of different types of radiation, each of which is able to ionise a gas, to act on a photographic plate, and to excite phosphorescence in certain materials. Of these the α and canal rays consist of positively charged particles of atomic magnitude; the cathode and β rays are negative rays, and consist of electrons; the X and γ rays are supposed to be ether pulses; and ultraviolet light consists of short ether waves. The δ rays stand by themselves, for, though they consist of negative electrons like the cathode and β rays, they have so small a velocity that they possess no appreciable ionising powers.

The present paper contains an attempt to find whether there is anything to be learnt from a comparison of the properties of the various rays.

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It appears to me to be a first deduction from such a comparison that in all cases the bulk of the ionisation which the rays effect is of the same character, and consists in the displacement of slow-moving electrons, or δ rays, from the atoms of the gas or other substance which they traverse. Let us consider the various rays in turn.

In the case of the cathode rays this principle has been clearly established by Lenard in the course of his long series of beautiful experiments. He has shown that cathode rays of the most varied speeds, impinging on bodies of various kinds, or traversing different gases, cause the liberation of slow-speed electrons from the atoms of the solid or gas. The speed of the electrons is in every case that due to the fall through less than ten volts. This is in no way a contradiction of the fact that cathode rays of high speed are also liberated from a solid surface struck by primary cathode rays; or from the atoms of a gas through which the primary rays pass. But, whether these high-speed secondary rays are scattered primary rays, or are true secondary rays, they must in their turn produce electrons of slow speed in the gas through which they pass; and so, directly or indirectly, by primary or secondary or tertiary or rays still more transformed, eventually

the great majority of the electrons set free in the ionisation-chamber of ordinary experiment are of the slow-speed type.

In the case of the α rays there is abundant evidence that their impact on, or emergence from, solid surfaces causes the ejection of slow-speed electrons. (J. J. Thomson, Cambridge Phil. Soc., Trans., February, 1905; Rutherford, "Nature," March 2, 1905; Logeman, Proc. Roy. Soc., September, 1906.) Now, it is generally characteristic of all these electric radiations that they are concerned with the individual atoms and molecules, and that they do not recognise any difference between the atom in the solid and the atom in the gaseous condition. Consequently, there is every reason to suppose that the heavy ionisation caused by an α particle in traversing a gas consists in the production of the same slow-speed electrons as are set free from a solid, and indeed no trace of faster-moving electrons has ever been found. The slow-speed electrons originated by α rays have been called δ rays, and the term may be applied to all such slow-speed electrons as we are now considering.

Again, it has been shown by Fuchtbauer (Phys. Zeit., November 1, 1906) that δ rays are emitted from a metal surface struck by canal rays, and here also there is every reason to suppose that gas molecules struck by such rays emit the same δ particles. The same author has shown by a direct comparison that the velocity of these particles is the same as that of the δ rays displaced by cathode rays, *i.e.*, about $3{\cdot}3 \times 10^8$ cm./sec., or the velocity due to about 20 volts, a velocity only slightly larger than that found by Lenard.

As regards β and γ rays, it is true that it has not been definitely proved that most of the ionisation which they cause is of the δ type. But this may be inferred from well-known experiments, such as those of Durack (Phil. Mag., May, 1903), or McClelland (Trans. Roy. Dub. Soc., February, 1906). When a pencil of β radiation is allowed to cross an ionisation-chamber normally, and fall upon the opposite wall, it gives rise to a secondary ionisation, less in quantity but not much less in speed than the primary. A tertiary radiation is caused by the secondary rays if they impinge on the walls of the chamber, and there will doubtless be still further derivations. But it appears that the quantity of the derived radiations dies away much more quickly than the speed. Thus the chamber is crossed and re-crossed (a few times) by electrons of high speed, able to traverse an average path of about 100 cm. in air at atmospheric pressure. If the chamber is first exhausted and air gradually admitted, it is found that the number of ions produced by the β rays is proportional to the pressure. The paths of the β rays will not

be appreciably affected by the introduction of the air; and so the experimental results are consistent with the simple hypothesis that the β particle (primary or secondary) makes slow-speed ions in proportion to the number of gas atoms traversed. Nor does any other hypothesis seem to be consistent with the facts. It cannot be supposed that the bulk of the ionisation which is caused in the ionisation-chamber consists of high-speed secondary rays, though, of course, these are originated when the primary rays strike the metal surface of the chamber, and to a small extent when they strike gas molecules. For if all the negative electrons set free by the β rays were of high velocity we should expect certain effects, as may be seen from the following considerations, and none of these effects have been observed.

Rutherford has shown (Radio-activity, 2nd edition, p. 434) that the α particle of Ra makes about 86,000 ions in air; that one β particle is emitted from Ra for every four α particles; and that the ionisation due to β particles is of the order of 1 per cent. of that due to α particles in the case of Ra in equilibrium. Thus the β particle of Ra produces some thousands of ions. This is also evident from the experiments of Durack (Phil. Mag., May, 1903), who has shown that the β particle produces about 130 ions per cm. in air at atmospheric pressure. Now, the β particle runs a course in the open air of an average length of 100 cm. This leads to an estimate of its ionisation even greater than that obtained by Rutherford. If all the electrons, so liberated, had a high velocity, the energy set free would be out of all proportion to that of the original β particle. Yet if we are to ascribe a high velocity to the electrons set free, it must be a very high one, for it has been shown by Allen (Phys. Review, August, 1906), that the secondary radiation of β rays consists of electrons moving with a speed approximating to that of the primary. We cannot suppose that all these electrons are of this high-speed type. Moreover, if this were the case, the free path of such electrons would become comparable with the dimensions of the ionisation-chamber, when the air pressure was only moderately reduced, and the electrons would then be beyond the control of the electric field. Thus the ionisation would not be proportional to the air pressure, as was found by Durack and McClelland. The difficulty as to the energy is not obviated by supposing each primary β particle to set free only a few secondary electrons of high speed, each of these to become in turn the originator of a few more, and so on. For if that were the case, a reduction of gas pressure would imply, not only that each primary electron set free fewer

secondary electrons, but that each of the latter set free fewer tertiaries, and so on, so that the ionisation would fall at a far greater rate than the pressure as soon as the free path of the electrons became comparable with the dimensions of the chamber. And, again, the β rays differ only in speed from cathode rays, which produce quantities of slow-speed electrons, even where their own velocity is great.

For these reasons I think it must be concluded that the β particle (and any high-speed secondary) produces slow-speed electrons along its path, in very much the same way as the α particle does, though not in such great numbers. The high-speed secondary rays, studied by McClelland, Allen, and others, are but few in number compared to the slow-speed electrons, though their greater energy puts them more in evidence. McClelland concludes from his experiment that the β rays do not produce any slow-speed electrons, when they strike a metal surface, which are comparable in number with the electrons displaced in the gas through which they have passed. This is quite consistent with what has been said above. There must be a few, but the number to be expected is quite small, for the β electrons dive so deep into the metal which they strike, and ionise so few of the molecules through which they pass, that very few of the slow-speed, highly-absorbable electrons can be discharged from the surface of the plate. Even in the case of the α particle these electrons are not readily observed; in the case of the β particle the difficulty must be much greater.

As regards X-rays, we have no such accurate measurements of the velocities of the electrons which are ejected from the molecules of a gas traversed by the rays, as we have in the case of the cathode rays, so far as I am aware. But a very large amount of labour has been spent on the investigation of the secondary radiation caused by the X-rays, from which we may gather much indirect evidence on the point. Perrin (Ann. Chim. Phys., xi., p. 496, 1897), has shown that the rate of production of ions per cc. by rays of given intensity is proportional to the pressure of the gas. Again, we know from the investigations of Curie and Sagnac, Townsend, and Barkla that metals struck by X-rays return a secondary radiation, which, in the case of the low atomic weights, may be considered to consist principally of scattered primary radiation, and in the case of the high atomic weights to contain both X-rays more absorbable than the primary and cathode rays. Dorn has shown that the latter have speeds averaging about 5×10^9 cm., so that they must produce considerable ionisation, consisting of δ rays, in the few millimetres of air close to the metal. The free path of electrons

having this speed is about one millimetre in air at atmospheric pressure. Since the X-rays do not appear to produce cathode rays of any speed from the air molecules, which they traverse, or from the molecules of any gas consisting of atoms of small weight, and since they produce much ionisation in some way or other, we may conclude fairly that they produce slow-speed ions themselves. Thus, whether they act directly or indirectly through cathode rays, the result is the same. The principal effect appears to be due rather to secondary than primary. As Sagnac remarks (Ann. Chim. Phys., 23, p. 196): "The transformation of X-rays, by increasing the activity at any point, permits the detection there of very penetrating X-rays, which would otherwise have passed unperceived."

In the case of the γ rays, such evidence as we have is also in favour of the existence of slow-speed ions, as the result of their action. It is known that β rays of high speed originate where they strike the molecules of a solid body (Eve, Phil. Mag., December, 1904); such an action may, therefore, be expected in the case of gas molecules also. It is possible, however, that there may be a differential effect in respect to heavy and light atoms, as in the case of the X-rays. The β rays will produce δ rays in their turn; and if, as is probably the case the γ rays are themselves able to ionise, the product will consist of δ rays, a conclusion which may be safely adopted from the analogies of the cathode rays on the one hand and the X-rays and ultra-violet light on the other. As in the case of the hard X-rays, the existence of γ rays is often made clear by the secondary effects which they produce, as has been shown by Becquerel.

To sum up what has been said, the ionisation which we measure in the ionisation chamber is almost wholly due to the emission of slow-speed electrons from the atoms of the gas contained in the chamber, or of the chamber walls; and this is true for all forms of radiation.

Moreover, there is some evidence to show that the speed of the δ rays is almost independent of the cause and manner of their production. As has already been said, Fuchtbauer found the velocity of the δ rays, caused by canal rays, to be about $3{\cdot}3 \times 10^8$, and the same in the case of cathode rays. Logeman found the velocity of the δ rays, emitted from a plate struck by α rays, to be such that they were deflected by a weak magnetic field. Ewers found (Phys. Zeit., March, 1906) the δ rays of polonium to possess a speed of $3{\cdot}25 \times 10^8$. With these may be compared Lenard's estimate, viz., 10^8, of the speed with which the ions leave a plate struck by ultraviolet light. It seems probable that we

have here a critical speed for the electron. Below this, it is not able to leave the parent atom. If its velocity exceeds the critical amount it possesses powers of penetration and of causing ionisation, the extent of these powers depending on the excess.

The existence of a common speed for all δ rays may, of course, imply that the ejection is not directly effected by the ionising agent, but that the latter simply precipitates the discharge. A man running through a battery might pull the triggers of some or all of the guns which it contained, and the velocity of the shot would not depend on the strength of the man, nor the rate at which he ran, nor how much energy he spent in the transit. And so it may be understood why δ rays are projected at a speed which is independent of the nature of the agent, as has been said above. So also it appears to be independent of the intensity of the agent's action. Fuchtbauer found the velocity of the δ rays produced by canal rays to be independent of the intensity of the primary rays; Lenard found the same for ultraviolet light. In my own experiments on the α rays (Phil. Mag., March, 1907), I have brought forward evidence to show that the amount of ionisation produced in an atom is proportional to the volume of the atom approximately. Taking this in conjunction with the rule that the ionisation produced in a gas is nearly proportional to the inverse of the speed, we have the very simple, if approximate, law, that the ionisation produced by an α particle in any atom under any circumstances is inversely proportional to the time spent inside the atom. This appears to point to the ionisation as purely a trigger effect. Not that the α particle spends no energy in the atom; it is clear it must do so, since its speed is gradually reduced, but there is not a direct connection between the energy spent and the number of ions produced. But whatever energy the ionising agent may spend, or in whatever way it spends it, it seems likely that the issue of the δ particle is the result of some disruption in the atom, or sub-atom, which is the same for all atoms and under all circumstances.

If we turn our attention now to all secondary radiation other than the δ rays, it seems to be, in general, a rough reflection or scattering of the primary. Allen has shown that there is only a little less velocity in the secondary rays than in the primary β rays, or in the tertiary than in the secondary. McClelland has measured the total ionisation produced by the secondary as compared with the primary β radiation; and since he used a small ionisation-chamber with which he ex-

plored the whole space traversed by the secondary rays, which chamber the secondary rays would, as a rule, completely cross if they entered it, it may be taken that he really compared the number of β particles in the secondary beam with the number of those in the primary. The numbers which he obtained varied from 15% to 50%, according to the substance, which is the order of things we should expect if the secondary were simply scattered primary radiation. Again, the loss of velocity of the cathode particles, which is found to occur on scattering at a plate, presuming the secondary radiation to be scattered primary, is just what we should expect. In the case of the α rays no secondary radiation other than δ rays has been found; but a small reflection of canal rays has been observed, *e.g.*, by Fuchtbauer (Phys. Zeit., March 1, 1906). Barkla has shown that the secondary radiation produced by X-rays consists in part of scattered primary radiation especially when the surface struck is of material whose atomic weight is low. The only cases in which a secondary radiation appears that is neither δ radiation nor reflected primary are those in which β rays are produced at the impact of X- or γ rays, and in which X-rays are produced by cathode rays. It is remarkable that in the former of these cases there is very great difficulty in accounting for the high speed which is possessed by the secondary radiation, caused by X-rays and γ-rays (Wien, Ann. d. Phys., December 28, 1905). It may well be that further research will bring these cases into better agreement with the rest.

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The next question which it is interesting to consider in relation to the various types of radiation is that of the law of absorption in passing through matter.

Absorption in the case of the material radiations appears to be due to two main causes: loss of energy, which causes a gradual loss of speed; and scattering, which means a diminution in the number of particles in the primary beam. There is a possibility of a third, viz., absorption of the flying particle by an atom which it is traversing.

In the case of the α particle, I have shown that the first of these causes operates alone, so that the particle pursues a rectilinear course throughout its career (Australasian Association for the Advancement of Science, January, 1904; Phil. Mag., December, 1904). It is the absence of any effective amount of scattering that makes the study of the motion of an individual α particle comparatively simple. The loss of energy in traversing an atom, or more exactly the probable loss in crossing a given space occupied by an atom, is nearly

proportional to the square root of the atomic weight, and the effects appear to be exactly additive.

On the other hand, if we consider a stream of β particles projected into matter, and attempt to find the history of their motion, we are faced with a problem of great complexity. If we look for an answer expressed statistically we must find the number of particles in each unit volume of the absorbing matter as a function of the time, the velocity, and the direction of motion. If, on the other hand, we try to follow the motion of any one particle, we must find the chance that the particle considered has any particular position, velocity, and direction of motion at any given time; which is really equivalent to finding the function just mentioned. Moreover, the data are very uncertain. We know so little of the interior of the atom that we are unable to say with what forces the electrons will be influenced when it penetrates within; whether, for example, we may neglect the action of the positive electricity of the atom, and consider only the electrons as repelling the β particle with a force varying as the inverse square of the distance, or whether we are to consider positives and negatives arranged in doublets, whose moment will be the important power, and whose law of attraction will not be that of the inverse square. It is a certain simplification to suppose that scattering is mainly responsible for the fading away of a stream of β particles. The experiments of Allen, McClelland, and others show that the secondary radiation has a velocity not much less than that of the primary; and, therefore, that this simplification is justifiable; though, clearly, it cannot be pushed too far. This allows us to concentrate our attention on the deflections of the particles only; but even then the difficulties are still immense. It is not like any problem in the kinetic theory of gases, for there we deal with established conditions; here with a gradual development from initial conditions.[1]

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[1] In his Conduction of Electricity Through Gases, 2nd edition, p. 376, Professor Thomson investigates the motion of a stream of β particles through an absorbing layer. It appears to me—I say it with very great diffidence—that the solution does not take a true account of the facts. The solution may be stated briefly thus:—Taking u, v, w as the components of the velocity V of the moving corpuscle, an expression is found for the probable change in u at the next encounter. Calling this change δu, we have $\delta u = -uK$, say, where K is a function of the mass of the corpuscle, the effective mass of the electron of the absorbing body, the velocity V of the corpuscle, which is taken as constant, the atomic charge, and the shortest distance between two corpuscles in the atom. K is then multiplied by the probable number of encounters in moving a distance δx along the axis of x, from which follows an exponential law for u in terms of x. It seems to me, in the first place, that, assuming such a multipli-

But if we turn from the theoretical to the experimental investigation we find a much more encouraging prospect. The experiments of Lenard are practically a complete graphical solution of the question. (See Taf. iv., Wied. Ann., Bd. 51). We know that an assemblage of atoms behaves just the same in respect to these radiations, when it is condensed in a solid or spread out as a gas. Thus the sketches which Lenard gives us showing the way in which the cathode rays diverge from a small window and scatter in going through various gases at different densities must be quite applicable to solids also.

Lenard found that his results could be accounted for on the supposition that there was an absorption according to an exponential law, over and above the weakening due to spreading from a centre.

If a β particle or cathode particle were liable to complete absorption by an atom which it entered, such an exponential law would result at once. As a matter of fact, it looks as if several violent deflections might take place before the final disappearance of the particle's activity. It looks, also, I think, as if deflections were usually not at all great during the progress of the particle through the atom, but were apt to be severe when they did happen, as if, in fact, the field of force which deflected the particle was strong but circumscribed. This would happen if the positives and negatives were arranged in doublets. When a particle is deflected from a beam crossing a thin plate, it starts off on a new path which leads much less directly to the open air, and its velocity is somewhat diminished. It may be, therefore, that the infrequency but severity of the particle's encounters makes it possible to look upon each encounter as an absolute, or at least a definite, loss to the stream, so that an exponential law results.

Certainly the application of this law to the interpretation of experiments has had very great success, both in respect to cathode and to β and γ rays. As examples of the latter we may take Rutherford's determination of the absorption of the β rays of uranium, and Godlewski's similar determination

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cation to have any meaning, the proper factor should have been greater than that adopted in the proportion of V to u, for in advancing a distance δx along the axis of x the corpuscle moves a distance $V\delta x/u$, not δx. If this change is made, the exponential form disappears from the answer. But, apart from this, it does not seem that the step is justifiable at all. It is tantamount to putting the corpuscle back in its old track after each encounter, and is equivalent to neglecting the existence of the function mentioned above, and the absolute necessity of finding it.

for actinium (Jahrbuch der Rad. und Elek., Bd. iii., Heft 2, p. 159). In experiments of this kind the radiating material is spread evenly on a level surface, and sheets of absorbing material are placed upon it. The ionisation produced in the space above the sheets is compared with the thickness of the sheets; and the two variables are found to be connected together more or less exactly by an exponential law. There is some difficulty whether such measurements give more nearly the number or the energy of the stream of particles which emerges from the plate, as Rutherford (Radio-activity, 2nd Ed., p. 134), and Thomson (Conduction through Gases, 2nd Ed., p. 375), have pointed out. The point was also discussed in my address to Section A of the Aus. Ass. for the Adv. of Science, Dunedin, 1904, p. 69. There is also an uncertainty due to the application of a formula to radiation from an assemblage of points which is really only applicable to a plane wave, or a stream moving normally to the plate. If a point source of radiation is placed below an absorbing plate of thickness d, and there is a true co-efficient of absorption λ, the fraction that emerges from the further side of the plate is not $e^{-\lambda d}$; much of the radiation passes obliquely through the plate and is absorbed to a greater degree than that which passes normally. This has often been pointed out, *e.g.*, by N. R. Campbell (Phil. Mag., April, 1905, p. 541), who also gives some figures from which the proper curve of absorption may be drawn. I am not aware, however, that it has been noticed that the form of the absorption curve, which is far from an exponential curve for a thin radiating layer, approximates much more closely to it for a thick radiating layer. And it is interesting to find that the experimental curves which are most nearly exponential are those for which the layers of radio-active material were thick compared to the penetration of the rays under investigation. As examples, we may take those of uranium and actinium already mentioned. On the other hand, the curve which H. W. Schmidt (Ann. d. Phys., Bd. 21, 1906, p. 651) has obtained for the β rays of RaC, the radio-active material being deposited in a very thin layer on metal foil, shows just about the amount of departure from the exponential form which is to be expected if the absorption is truly exponential, and there is only one absorption co-efficient, not two, as Schmidt has suggested.

The following figures give the proportional amount of the original radiation which passes through a plate of thickness n/λ, where λ is the absorption co-efficient: (1) for a thin layer; (2) for a thick layer. The figures are also given, for the sake of comparison, for the case of a plane wave, or a pencil of rays passing through the plate normally:—

μ.	Radiation from thin layer.	Radiation from thick layer.	Plane wave (purely exponential).
·0	1·000	1·000	1·000
·1	·723	·834	·905
·2	·573	·702	·819
·3	·467	·600	·742
·4	·387	·510	·671
·5	·323	·437	·607
·6	·274	·378	·548
·7	·235	·328	·498
·8	·200	·283	·450
·9	·171	·248	·405
1·0	·145	·214	·368

The absorption of a material used in a thin sheet naturally appears greater than the absorption when the thickness of material is increased, because the rays which are moving obliquely are absorbed first.

The absorption of γ and X-rays appears to follow a purely exponential law so far as experiment has been made. The δ rays are absorbed by molecules immediately on their production, and cannot be said to show absorption effects.

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Having thus discussed the properties of the various rays which do exist, it seems interesting to make an attempt at the estimation of the properties of some rays which might exist, though the fact has not been proved as yet. Radioactive substances emit both positive and negative particles. It does not seem at all out of place to consider the possibility of the emission of neutral particles, such as, for example, a pair consisting of one α or positive particle and one β or negative particle. The recent additions to our knowledge of the laws of absorption of α and β particles give us some grounds on which we may attempt to found an estimate of the properties of such pairs.

We know that the α particle moves in a rectilinear course throughout its whole range, and passes through the atoms which it encounters without deflection. It does not pursue a course which is straight on the whole, but zig-zag in detail; the direction and amount of a particle in motion are the whole characteristics of that motion at any instant, and no memory of any previous motion exists. If, therefore, a particle pursues a straight line in its motion as a whole, it must keep to that line entirely and make no excursions from side to side. We must, therefore, suppose that an atom, or at least an α particle, endowed with sufficient speed, can pass directly through another atom without appreciable deflection. The α particle loses speed as it penetrates

atoms in this way; and there can be little doubt that its charge, that is to say, the field which is about it, is a main cause of this loss of energy. But if a β particle is associated with the α particle so that the tubes of induction pass from one particle to the other, and the field is greatly contracted, it would seem that the chief cause of the stopping of the α particle has been removed.[2] The penetrating power of a pair might be very great indeed, and its ionising power correspondingly reduced; for, although there does not seem to be a direct connection between energy spent and ionisation produced, there can be no doubt that the two are simultaneous. The limitation of the field of the pair would depend on its moment; if the latter was small, that is to say, if the positive and negative were close together, the field would be more circumscribed. It is, therefore, possible to provide for pairs to have varying penetrating and ionising powers; a pair of small moment being a good penetrater but a bad ioniser. Such a pair would be incapable of deflection by magnetic or electric fields, and would show no refraction. It is conceivable that it might show a one-sided or polarisation effect, for if it were ejected from a rotating atom it would itself possess an axis of rotation.

When X-rays were first investigated, and again when γ rays were discovered, it was often suggested, in each case, that the radiation might consist of material particles. Röntgen himself proposed in the third of his memoirs a theory of this nature. But it was always felt that the difficulty of accounting for the great penetration of these radiations was insuperable. It seems now that this difficulty was quite exaggerated, and even imaginary. It does not appear out of place, therefore, to reconsider the position in the light of the more recent knowledge.

Assuming, then, that the neutral pair has great penetrating, but weak ionising, powers, is uninfluenced by magnetic or electric fields, and shows no refraction, it does so far conform to the properties of the γ ray. And, further, if it has any moment at all, and therefore any external field, it may at last suffer some violent encounter which will resolve it into a positive and a negative, an α and a β particle. Of these the β particle would be the one possessed of much the greater velocity, and would appear as a secondary ray. Thus, in the neighbourhood of the point of impact, an ionisation would appear of much greater intensity than anything produced along the track of the pair itself. So Becquerel has found the action of the γ rays on a photographic plate to be almost entirely due to the secondary rays which they produce.

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[2] See also Rutherford's Radioactive Transformations, p. 272.

On this view the appearance of the β secondary ray would be really a scattering of the incident ray; and this would make the γ ray fall into line with other radiations whose secondary radiations are either scattered primary or δ rays.

If the gradual disappearance of a stream of γ radiation were caused by collision in this way, the number disappearing in any unit of length of the course would be proportional to the total number in the stream, so that an exponential law would result.

It appears, therefore, that all the known properties of the γ rays are satisfied on the hypothesis that they consist of neutral pairs.

It is interesting to carry the speculation a little further, and to observe that a pair possessing a very circumscribed field might exhibit no ionisation effects whatever, and be capable of very great penetration. Its final end might be an incorporation into an atom traversed (as has been suggested to me by Professor Rutherford in reference to the α particle). Thus, penetrating radiation of this kind might exist in some quantity without our being aware of it, and might be an important agent in the breaking down and building up of atoms.

If we attempt to explain the properties of the X-ray on the supposition that it is a neutral pair, we meet with a difficulty which does not occur in the case of the γ ray. For it has been shown by Marx (Phys. Zeit., p. 268, 1905) that certain X-rays move with the velocity of electric waves in wires, and therefore of light. Now, it is difficult to conceive that material particles can move with such a speed and yet be scattered on impact with atoms. Yet in other ways the behaviour of X-rays is so consistent with what we should expect on a neutral-pair theory that it does not seem either useless or uninteresting to consider the matter from that point of view.

In the first place we have the necessary absence of deflection in electric and magnetic fields, and of refraction; the possibility of a kind of polarisation quite different in character to that of light; great penetration, whose amount may vary with the moment of the pair, or with the velocity if the latter is a variable; the production of secondary rays when the ray strikes an atom, with an easy explanation of why the ray, when striking a light and yielding atom, is reflected more or less unchanged, yet, striking a heavy atom, is shattered with the production of much easily absorbed secondary radiation of the cathode ray type (Barkla, Phil. Mag., June, 1906). If the X-ray is an ether pulse it is difficult to understand, as Thomson has shown (Conduction

of Electricity through Gases, pp. 294-297), why the spreading pulse should only affect a few of the atoms passed over, why the secondary cathode rays are ejected with a velocity which is independent of the intensity of the pulse which weakens as it spreads, and why it should be able to exercise ionising power when its energy is distributed over so wide a surface as that of a sphere of, say, ten or twenty feet radius. All these phenomena are capable of quite simple explanation if we suppose the ray to be a neutral pair which has only a local action, *i.e.*, can only affect the molecules which it traverses, which can penetrate to great distances, which loses very little speed as it goes, and gives rise to a cathode ray when it is broken by impact.

The hypothesis can readily be developed so as to furnish an explanation of the polarisation effects which Barkla *(loc. cit.)* has worked out with so much success. If the cathode particles so affect the motion of an atom as to make it throw off a pair, then the plane of rotation of the pair will contain the direction of its translatory motion. And if such a pair fell upon a reflecting surface, it might naturally be taken up only by an atom revolving in the same plane, and, if ejected again, continue moving and revolving in that plane, thus exhibiting exactly the effects which Barkla has found.

The sudden arrest of a cathode particle must originate an ether pulse. But, as a matter of fact, it has never been shown that such sudden stoppages do take place. Wien has calculated (Ann. d. Phys., December 28, 1905) that the particles must come to rest in a space of about 10^{-10} cm., if the energy of the X-rays is to be accounted for in this way, even supposing the whole of the cathode rays to be effective; and the appearances of the bundles of reflected β and cathode rays rather point to gradual deviations with a very slow diminution of energy, and therefore very little radiation. On the other hand, we know that atoms are set in motion with very high speeds inside the vacuum tube, and that the gas in the X-ray tube is largely driven into the walls (Campbell Swinton, Chemical News, March 22, 1907) in a manner which reminds us of α rays penetrating a solid.

It is possible that the example of the α particle shows that a pair cannot possess a velocity greater than 10^9, since at a higher speed it would be stripped of an electron, and become an α particle. J. J. Thomson has suggested that at this critical speed the α particle becomes electrically neutralized by the attachment of an electron. Presumably such a pair would then go on as a γ ray. No such consequence has been observed; and on the present hypothesis it would be better to suppose that the α particle ends its career by

being taken up by an atom, as Rutherford has suggested. There is no reason to suppose the γ ray or X-ray to possess any great speed, so as to give it enough penetrating power. The latter might depend rather on the limitation of the field of the pair, and a sufficient range for the velocity can be found between the minimum speed of the α particle and the minimum speed necessary for penetration, which appears to be about 10^8 for a charged particle, but may be less for one without charge. A moderate speed would account for the reflection or scattering of the X-ray, and would indeed be necessary for this purpose. It is here that the neutral-pair hypothesis clashes with the experiment of Marx, and, unless some way out is found, must remain simply an interesting comparison. In the case of the γ ray the hypothesis seems to fit in very well with the known facts.

THE NATURE OF RÖNTGEN RAYS.

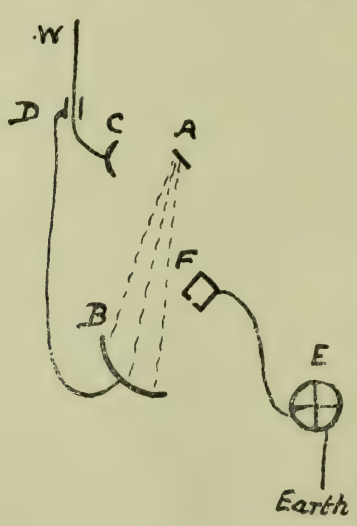
By W. H. BRAGG, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide.

[Read June 4, 1907.]

In a paper read before this Society at its last meeting (May 7, 1907), I pointed out that the properties of the X-rays were, with one important exception, generally consistent with the theory that they were of a material nature, being composed of neutral combinations of α and β particles. But it was difficult to reconcile this theory with the result announced by Marx, viz., that the X-rays possessed the velocity of light.

On further consideration of Marx's beautiful experiment I find that his result is by no means so antagonistic to the material nature hypothesis as I at first imagined it to be. To see this clearly it will be necessary to consider briefly the details of the experiment.

An electric pulse is made to travel along a wire, W, as shown in the accompanying sketch. When it reaches the cathode, C, cathode rays are driven against the anode, A, and X-rays are given out, some of which travel towards the saucer-shaped electrode, B. At the focus of B is a small Faraday cylinder, F, connected to an electrometer, E. A small impulse is derived from the wire, W, by electrostatic induction at D, and travels down to B. If the various distances



and wire-lengths are properly adjusted, so that the X-rays arrive at B at the same moment as the derived impulse, electrons are liberated at B by the rays, and guided by the impulse into the cylinder, F, and thence to the electrometer. If now the distance of the X-ray bulb from B is altered, say, by an increase of 10 cm., the wire from D to B has to be lengthened by 10 cm. Thus, according to Marx, the X-rays travel with the same velocity as the impulse in the wire, and therefore with the velocity of light.

But it is to be remembered that the electrons which are liberated by X-rays have an initial velocity averaging about 5×10^9 per sec., *i.e.*, a speed due to thousands of volts, and are scattered in all directions from the surface on which the rays fall. Neither the weak impulse applied to B by the wave coming along the wire, DB, nor the peculiar form of the surface, B, could have any sensible effect in the way of guiding these fast-moving electrons into the cylinder, F. Only slow-moving electrons or δ rays could be guided by such means. It is no doubt true that X-rays do liberate a certain number of δ rays, but it is clear that the experiment of Marx is quite consistent with the hypothesis that the X-rays are complex, and consist in part of ether pulses travelling with the velocity of light, and producing δ rays, and in part of material particles, or pairs, travelling at a speed as yet undetermined, and exciting high-speed cathode rays.

This being the case, it is desirable to consider the material-nature hypothesis more in detail, and to contrast it with that of the ether pulse.

In the first place, either theory can readily account for the great penetration of the X-ray, for the absence of true reflection and refraction, for the absence of deviation in electric or magnetic fields, and for polarization of a type somewhat different from that of light, and agreeing with experiment. I have discussed these points in the previous paper.

It seems to me that the material-nature hypothesis shows to advantage when we consider the secondary radiation of the X-rays. The rays cause the emission of cathode rays whose speed averages about 5×10^9 (Dorn). We have no experience of any ether wave causing the emission of any but δ rays, *i.e.*, electrons with a speed of about 10^8. It can hardly be said that differences in intensity of the ether pulse can account for this remarkable contrast. For the speed of the δ rays caused by ultra-violet light has been shown by Lenard to be independent of the intensity of the light; and the velocity of the X-ray secondary radiation does not depend on the intensity of the X-rays. It may be argued that the breadth of the pulse is the prime factor, on the grounds that

Lenard found the velocity of the δ rays due to ultra-violet light to depend somewhat on the nature of the light; but it is hard to believe that a diminution of the width of the pulse, no matter how extreme, can increase the energy of the ejected electron about a thousand times.

But if we regard the secondary radiation as the result of the break-up of a neutral pair, the high velocity of the ejected electron (5×10^9) may be more readily explained. The action must be entirely different from that of ultra-violet light.

It is difficult to found any arguments for or against either theory on considerations of the relative energies of the original cathode stream, the X-rays, and the secondary rays. For if the energies of any transformation do not balance, it is easy to square the account by postulating either some release of the internal energy of the atom, or the reverse, viz., the absorption of energy by the atom involving an apparent disappearance of the visible energy. In the case of the ether-pulse theory it is necessary to suppose that the secondary radiation derives its energy from the atom's internal store (Conduction of Electricity through Gases, 2nd Ed., p. 321). Also, as mentioned in the previous paper, there are difficulties in reconciling the proportion of X-ray energy to cathode-ray energy, with the probable circumstances of the impact of the cathode rays. (Wien; Ann. d. Phys., xviii., p. 991, 1905, and xxii., p. 793, 1907; van der Waals, Jr.; xxii., p. 603, 1907). On the neutral-pair hypothesis, the cathode rays would probably cause the release of the pairs, which would derive much of their energy of motion from the atom; it might not be necessary to invoke the aid of the atomic energy in order to account for the energy of the secondary radiation.

There is another entirely different argument, which seems to support the neutral-pair hypothesis.

The α, β, and γ rays all ionize the gases which they traverse. It has just been shown by Kleeman [1] that the ionisation per atom due to β and γ rays is nearly proportional to the ionisation per atom due to α rays (and, therefore, approximately proportional to the volume as I have shown, Proc. Roy. Soc. of S.A., Oct., 1906; Phil. Mag, March, 1907). The figures for the heavier atoms are rather larger for the β than the α rays, and still larger for the γ rays. It is known that the ionisations due to X-rays differ considerably from those due to γ rays

(1) Mr. Kleeman has been good enough to inform me of his results by letter; but I believe I am at liberty to quote them, since he has, I understand, recently read a paper on the subject before the Royal Society.

when the X-rays are soft; but approximate to them when the X-rays are hard.

All this fits in excellently with the theory that all four types of rays are material. Take the α particle first, since its circumstances are the most simple. It moves directly through the atoms, without scattering or transformation. It liberates ions in the form of δ rays as it goes, approximately according to the volume law. The β ray is also a charged particle, and it is readily to be supposed that it would, if its whole motion were rectilinear, liberate ions according to the same law (comparing atom with atom), as the α particle, though the numbers would be less. But the β particle is liable to scattering, and each act of scattering generally implies an increase in the length of the particle in the gas, and increased ionising power since its speed is a little diminished. Now, scattering is proportional to the atomic weight, whilst the ionisation is more nearly proportional to the square root of the atomic weight. Thus, a heavy atom is the cause of more than its proper amount of ionisation; and so we find in Kleeman's table that the ionisation of the atoms Cl, Br, and I are rather higher than in the case of the α particle. Again, the γ particle is liable to resolution into its elements, with a relatively large amount of ionisation. Since this transformation is chiefly effected by impact with heavy atoms, these latter will be the cause of a disproportionately large ionisation, as compared with the α rays; and this is also shown by Kleeman's figures. Passing on to X-rays we find a further illustration of this effect, until we come to very soft rays, when we find that the heavy atoms are the occasion of exceedingly large ionisation (Conduction of Electricity through Gases, 2nd Ed., p. 300). There is a good continuity in all these phenomena, with gradual divergences just where we should expect them. The α, β, γ, and X-rays all produce the same primary ionisation, comparing atom with atom, and differ only in the effects due to scattering and transformation; that is to say, differ only as regards their production of secondary ionisation. Now, the α and β rays are certainly material particles, possessing electric fields. There is, therefore, a reasonable argument that the γ and X-rays are also material, and possess electric fields. This is the case if they are pairs, and the smaller the moments are the more circumscribed are the fields and the less the ionisation and loss of energy.

If the X-rays contain ether pulses only, it is difficult to see why their effects should run so exactly in parallel with those of the α and β rays.

As I have already pointed out, the neutral-pair theory

offers the more natural explanation of the facts that only a minute fraction of the atoms traversed by a bundle of X-rays are ionized, and that the character of the ionisation is independent of the intensity of the rays.

It is clear from Marx's experiment that some ether waves are present in a bundle of X-rays. Their presence will readily account for the diffraction effects of Haga and Wind.

To sum up a curious and interesting situation, it may be said to be clear that X-rays contain ether pulses, but that a large number of X-ray properties are not easy to explain on the hypothesis that the rays contain ether pulses only. The difficulties disappear on the hypothesis that they contain neutral pairs also: a hypothesis which is by no means improbable *a priori*. But the existence of these pairs has not yet been absolutely proved.

I should like to add one remark in reference to the γ ray. If the latter is material and contains an α particle, this fact must be considered in reckoning the number and magnitude of the steps from the atomic weight of radium to that of lead. It has been suggested to me by my colleague Dr. Rennie that the rayless changes of Ra may really be accompanied by the emission of neutral pairs of very small moment. This adds another unknown factor to the calculation. The energy involved in such emissions might be quite small, and, moreover, if pairs can be taken up into atoms, so as to form new atoms, the whole of the energy may not appear as heat.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part V.

By Jos. C. Verco, M.D. (Lond.), F.R.C.S. (Eng.).

[Read May 7, 1907.]

During the last session in Adelaide of the Association for the Advancement of Science, Mr. Hedley, of the Australian Museum in Sydney, kindly examined, with me, a number of my South Australian shells, and has since compared them with types in the Sydney Museum. We have thus been able to identify several of our forms. He also took with him all my Pteropods, and returned them named. A trip to the three bays in the South-East of our State—MacDonnell Bay, Guichen Bay, and Lacepede Bay—provided a quantity of minute beach material, which has already proved to be very rich in novelties, and has provided examples of larger shells in such excellent condition as to allow one to speak more certainly upon some previously questionable points.

Family PATELLIDÆ, Guilding.

Genus Patella, Linnæus.

P. ustulata, Reeve.

This species was found in abundance by me this year on the rocks at Western Beach, Robe. Here and at MacDonnell Bay it was seen in better condition and in greater numbers on the vertical face of the rocks, just above low water, than on the submerged reefs, less eroded and less encrusted. A variant was taken at Robe, suggesting at first a new species, a rather narrow oval shell, with 22 to 24 large, rounded, close-set radial costæ, with one feeble or no interstitial riblet. They were found, however, to merge insensibly into the usual forms.

P. hepatica, Pritchard & Gatliff.

At Beachport, on the shore, several dead shells were collected, some quite typical, with oblong oval border, and crowded, fine, equal radial riblets. But, though retaining this outline, their sculpture gradates into the sub-distant costæ with intermediate riblets of *P. ustulata*, Rve. In one individual the sculpture is that of *P. hepatica* until it is 18 mm. long, when 24 valid white scaly ribs arise. Another shell, measuring 41 mm. by 36 by 20, is provided only with uniform crowded finely-scabrous riblets, combining the sculpture of *P. hepatica* with the shape and size of the largest of our *P. ustulata*. Every gradation, too, can be traced between the oblong-oval

and the roundly elliptical forms. The opinion expressed in Trans. Roy. Soc. South Aust., 1906, vol. xxx., p. 207, as to the identity of these two species is confirmed.

Genus Helcioniscus, Dall.

H. limbatus, Philippi.

Patella limbata, Philippi, Abbild. und Besch. Conch., vol. iii., p. 71, pl. iii., f. 2, 1849; Reeve, Conch. Icon., vol. viii., pl. xiii., f. 29, a, b, 1854; Angas, Proc. Zool. Soc. Lond., 1865, p. 185; Ten. Woods, Proc. Roy. Soc. Tasmania, 1877 for 1876, p. 48; also 1879 for 1878, p. 45; Pritchard & Gatliff, Proc. Roy. Soc. Vict., vol. xv. (new series), part 2, p. 192, 1903.

Patella (Helcioniscus) limbata, Phil., Pilsbry, in Tryon's Man. Conch., 1891, vol. xiii., p. 143, pl. lxxi., f. 53 to 56, and pl. xvii., f. 28, 29.

Hab.—That of the type is given by Philippi as "New Holland" (Largilliert); Reeve records it from "Signet Bay, North Australia: Dring"; Angas, "Port Lincoln, South Australia"; Ten. Woods, "Southport, Tasmania"; Pritchard and Gatliff, "Cape Otway, Victoria." It has been taken at the Neptunes and Thistle Island, and in Spencer Gulf by Dr. Torr; on Yorke Peninsula by Mathews; at Encounter Bay by myself. I did not find it at Kingston, Robe, Beachport, or MacDonnell Bay.

Dim.—The largest dimensions given by Ten. Woods are 71 mm. by 64 by 32; but one from Yorke Peninsula measures 77 by 64 by 33.

Philippi, Reeve, Angas, Pilsbry, and Pritchard & Gatliff regard it as a good species; but Ten. Woods in 1878 wrote: "I regard this shell as a variety, or not even a variety, of the preceding (*P. tramosericus*, Martyn). The somewhat broader ribs may distinguish it." Tate & May in their census of the Marine Moll. of Tasmania, Proc. Linn. Soc. of New South Wales, vol. xxvi., 1901, p. 141, accept this view. Among the shells collected by Dr. Torr in Spencer Gulf is a facsimile of Philippi's type figure, in shape, size, colour, and erosion. Others, up to 55 mm. in length, have the apex perfect. Instead of being yellowish they may be of a deep salmon tint, and instead of 32 may have only 22 ribs, much broader than in the type, and thus differ still more than this from *P. tramoserica*, Mart. On the other hand, a unicoloured salmon-tinted shell from Beard Peninsula, West Coast of South Australia, in its ribbing comes between both species; and a small shell from Encounter Bay in its shape and flat rounded ribs approaches *H. limbatus*, and yet in its 44 ribs and red, yellow, and black radial markings is allied to *H. tramosericus*. I lean to the view of identity with extreme variation; but my series is not very large, and does not furnish such gradations as to warrant an absolute conclusion.

Genus NACELLA, Schumacher.

N. parva, Angas.

Hab.—One example dredged dead at 62 fathoms N.W. of Cape Borda: several found in shell sand, Guichen Bay, which is its most easterly known station.

N. crebristriata, Verco.

Hab.—The type locality was not exactly known, but was judged to be Moonta Bay. I have since taken several examples in shell-sand at Guichen Bay. There are variations from the type. The anterior slope may be sub-convex, or it may be slightly excavated immediately below the apex. Some are more compressed laterally than the type, others tend more to an elliptical outline. There may be about sixteen equidistant pink radii, or the shell may be uniformly of a light pink tint.

N. stowæ, Verco.

Hab.—Guichen Bay beach, in shell-sand. No variations from the type.

Family ACMÆIDÆ, Philippi.

Genus ACMÆA, Eschsholtz.

A. flammea, Quoy & Gaimard.

Patelloidea flammea, Q. & G., Voy. de l'Astrolabe, Zool., vol. iii., 1834, p. 534, pl. lxxi., f. 15 to 24.

My observations on this variable shell in Trans. Roy. Soc. South Australia, vol. xxx., 1906, p. 212, were almost entirely based on dredged shells. A collection since gathered from the rocks at Robe, Beachport, and MacDonnell Bay enables me to add something further. As a rule the exposed shells are much more eroded, and their ribs are ruder and less numerous, and they are of the *A. jacksoniensis*, Reeve, form rather than of the *A. crucis*, Ten. Woods. Many of these were much narrowed anteriorly, so as to be really oval or egg-shaped instead of uniformly roundly elliptical. Some of the smaller individuals tend also to be pyramidal rather than conical, with four obsolete angles occupying the situation of the intervals between the arms of the Maltese cross. None were found with radial ribbing so fine as presented on some of the dredged specimens.

In most the cross was plainly visible, or indistinctly when held up to the light. One showed the anterior and both lateral arms fused into one mass, and the posterior arm very broad, so as to give a quite black shell with two narrow dead white radii at the postero-lateral parts. Another was a black shell with four narrow white radii. Another had five

equal black arms, due to a white wedge in the centre of a wide posterior black patch. Another common peculiarity was that the white concentric band inside, just above the articulated dark and white border, had two radial extensions to the margin in the postero-lateral regions; and these, quite marked in the shells *with* the cross, were frequently distinct in those *without* the cross, and enabled the species to be certainly recognized.

Family COCCULINIDÆ, Dall.

Genus Cocculina, Dall.

C. coercita, Hedley.

Cocculina coercita, Hedley, Records of the Austr. Mus., vol. vi., part 4, 1906, p. 289, pl. liv., f. 1, 2.

Type loc.—80 fathoms off Narrabeen, New South Wales; also 300 fathoms east of Sydney (Hedley). South Australia, one example at 130 fathoms off Cape Jaffa (Verco).

Family VERMETIDÆ.

Genus Vermicularia, Lamarck, 1799.

V. Nodosa, Hedley.

Vermicularia nodosa, Hedley, Records of the Austr. Mus., vol. vi., part 4, 1906, p. 292, pl. liv., f. 8.

Type loc.—80 fathoms off Narrabeen, New South Wales. Dredged, 55 fathoms off Cape Borda, many; 150 fathoms off Beachport, one (Verco).

Family TRITONIDÆ.

Genus Cymatium.

C. kampylum, Watson.

Nassaria kampyla, Watson, Jour. Linn. Soc. Lond., vol. xvi., p. 594.

Nassaria campyla, Watson, Chall. Rep., vol. xv., 1886, p. 405, pl. xiv., f. 12. *Type locality*, "Off Sydney, 410 fathoms, green mud." *Lampusia nodocostata*, Tate & May, Trans. Roy. Soc., S. Austr., 1900, vol. xxiv., p. 90; *type locality*, east coast of Tasmania, 2 examples (W. L. May),; also Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., p. 355, pl. xxiii., fig. 2; *Lotorium nodocostatum*, Tate & May, Kesteven, Proc. Linn. Soc. N.S. Wales, 1902, vol. xxvii., pp. 463, 479, f. 1, 4; *Cymatium kampyla*, Watson, Hedley, Records of the Austr. Mus., vol. vi., part 3, p. 213.

The species was taken by Mr. Hedley and others in abundance at 300 fathoms, off Sydney, and with this material he was able to identify the Tasmanian shell with Watson's species. In my dredging off Beachport and Cape Jaffa I took more than 750 examples, mostly immature, and all dead. They ranged from 90 fathoms to 300; and were most

common at 110, 130, and 200 fathoms. They appear to live at some greater depth, for the living example which formed the Challenger type was taken at 415 fathoms. Considerable variation from the type is seen. Its proportions are 1·67 inches long and ·8 broad, but these may be 1·45 and ·6, giving a much more slender shell. Some individuals are more solid than others, and these usually have bolder sculpture, in axial costæ and spiral liræ. This is very noticeable in the whorls following the protoconch; the first may be merely granulated, and the second show only obsolete radial and spiral sculpture. When there is any ornament it is seen as yellow-brown spiral bands between the raised liræ, generally three in the spire-whorls and about six on the body-whorl, the last two or three tending to fuse. They are interrupted by the varices, which remain white.

Family SIPHONARIIDÆ.

Genus Siphonaria, Sowerby, 1824.

S. diemenensis, Quoy & Gaimard.

S. diemenensis, Quoy & Gaimard, Voy. de l'Astrolabe, Zool., vol. ii., p. 327, pl. xxv., figs. 1-12, 1833; Reeve, Conch. Icon., vol. ix., pl. i., fig. 1, 1856; Ten. Woods, Proc. Roy. Soc. Tasmania, 1877, pp. 56 to 58; and 1878, p. 46; Adcock's Handlist of Aquatic Moll. of South Australia, 1893, No. 457; Tate & May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., part 3, p. 418; Pritchard & Gatliff, Proc. Roy. Soc. Vict., 1903, vol. xv. (n.s.), part 3, p. 220.

S. denticulata, Quoy & Gaimard, *op. cit.*, p. 340, pl. xxv., figs. 19, 20; Reeve, *op. cit.*, pl. i., fig. 4; Ten. Woods, *op. cit.*, 1877, p. 54, 56, and 1878, p. 47; Adcock, *op. cit.*, No. 454.

S. scabra, Reeve. Conch. Icon., vol. ix., pl. i., fig. 2.

Type loc.—Of *S. diemenensis*, D'Entrecasteaux Channel, Tasmania (Quoy); of *S. denticulata*, "The southern part of New Holland at Western Port, and probably also at King George's Sound" (Quoy); of *S. scabra*, Port Jackson (Reeve).

Obs.—Tate & May and Pritchard & Gatliff unite the first two as one species, and the latter authors unite all three.

Our shell is very variable. It may be high and steeply conical, or so depressed as to have only a trace of cavity: rarely thin and delicate, generally of moderate thickness, sometimes quite solid. The ribs may be as few as 17 or very numerous, distant, or crowded; high, narrow, and sharp-cut, or low, broad, and rude; straight, smooth, and regular, or crooked, rough, irregularly noded, or scabrous. Rarely they are quite colourless, when taken alive; or yellowish, with faint smokiness in the intercostal spaces. They are brown throughout, or with bluish-white ribs and bluish-black between. But all these variations intergrade. It extends all along our coastline.

S. baconi, Reeve.

S. baconi, Reeve, Conch. Icon., 1856, vol. ix., pl. vi., fig. 30; Pritchard & Gatliff, Proc. Roy. Soc. Vict., 1903, vol. xv. (n.s.), part 3, p. 221.

Type loc.—"Swan River."

The three shells from the Cuming Museum in the Natural History Museum (Brit. Mus.), London, from Swan River, labelled *S. baconi*, Reeve, are similar to ours. It was given in Adcock's Handlist, No. 455, as *S. luzonica*, Reeve: but the types of this species, and from which his figures were drawn, are from the Philippine Islands, and have only 9 to 13 ribs, much stouter than ours. *S. baconi* is probably the species catalogued by Tate & May in their Tasmanian Census as *S. albida*, Angas, in Proc. Linn. Soc. New South Wales, 1901, vol. xxvi., p. 419.

It has been taken from MacDonnell Bay to Streaky Bay, and up St. Vincent and Spencer Gulfs. It is found on the rocks in the South-East, which are completely exposed at low tide, and on the reefs which are not exposed: also on the ocean shore, subject to the rough seas from the break of the rollers, and the smooth water in the quiet bays and gulfs. The shells appear to be larger in the rougher South-East than in quiet places like Hallett Cove, etc. The size may reach 30 mm. by 23 by 5·5. They are very flat, as low as 4·75 mm. in a shell of 25 mm., the greatest height being 6 mm. in a shell of 20 mm. They are mostly roundly elliptical, rarely nearly circular, more rarely oblong-elliptical. Usually they are quite thin, but those from rough water may be very solid. Generally much eroded, especially when senile, they may show no sculpture. There may be only 17 to 20 ribs standing up validly above all secondary riblets, or there may be 44 nearly equal radii. Their colour is a dull white, rarely yellow. In some, especially in juveniles, or the earlier portions of mature ones, and in the thinner forms, tiny blackish or brownish spots may be scattered about irregularly, sparsely, or abundantly, or they may form clouds, rings, or patterns. The interior is quite white, the horseshoe amber-coloured. Sometimes within the horseshoe, and in a depression in front of it, and along the siphon furrow, is a fuscous clouding. The animal is of a light saffron-yellow colour.

S. albida, Angas.

S. albida, Angas, Proc. Zool. Soc., Lond., 1878, p. 314, pl. xviii., figs. 16, 17; Adcock, Handlist, etc., 1893, p. ii., No. 456.

Type loc.—St. Vincent Gulf, South Australia.

I examined the shell at the Natural History Museum (Brit. Mus.), London, in 1899. It was mounted as "Type

Adelaide." I could not match it; it is more conical than any *S. baconi*, Reeve, I had or have since obtained. It is very thin, but is evidently not a worn shell, and is very glistening internally. It must be an extreme variant if it be *S. baconi*. May it be an albino of one of the forms of *S. diemenensis*, Quoy?

S. zonata, Tenison Woods.

S. denticulata, Quoy & Gaimard, var. *tasmanica*, Ten. Woods, Proc. Roy. Soc. Tasmania, 1877, p. 54; *S. zonata*, Ten. Woods, *op. cit.*, 1878, p. 99, and p. 47; Pritchard & Gatliff, Proc. Roy. Soc. Vict., 1903, vol. xv. (n.s.), part 3, p. 221.

It was listed by Tate and May in their Census for Tasmania, as *S. tristensis*, Sowerby, in Proc. Linn. Soc. New South Wales, 1901, vol. xxvi., pt. 3, p. 419, by misidentification.

It is found at MacDonnell Bay on the rocks above low water, and at Beachport, mostly much eroded. But perfect specimens may attain full size of 22·5 mm. by 19·5 by 9, and may show a perfect protoconch of a deep brown colour, hooked backwards, and spirally curved, with the nucleus of a deep amber tint deviated to the left, on which side alone its two whorls, quite distinct, smooth, round, and slightly elate, are visible.

S. stowæ, Verco.

S. stowæ, Verco, Trans. Roy. Soc. South Austr., 1906, vol. xxx., p. 223, pl. viii., figs. 3 to 8.

Type loc.—Pondolowie Bay, Spencer Gulf. The habitat has not been extended beyond Encounter Bay.

Family GADINIIDÆ, Gray.

Genus Gadinia, Gray, 1824.

G. angasi, Dall.

Gadinia conica, Angas, Proc. Zool. Soc. Lond., 1867, p. 115, No. 27, pl. xiii., fig. 27. *Type locality*, "Port Jackson Heads (Coll., Angas)"; also p. 220, No. 221, "Coodgee Bay."

Gadinia angasi, Dall, Amer. Jour. Conch., 1870, vol. vi., p. 11; Pritchard & Gatliff, Proc. Roy. Soc. Vict., vol. xv. (n.s.), part 3, p. 222, "Portsea, Port Phillip; Western Port."

Taken on the ocean beach at Port MacDonnell, Beachport, and Robe, not rare, and in good condition (Verco); Head of Great Australian Bight (Tate); Rosetta Head, Encounter Bay (Tate).

Family MODIOLARCIDÆ, Gray.

Genus Modiolarca, Gray.

M. tasmanica, Beddome.

Modiolarca tasmanica, Beddome, Proc. Roy. Soc. Tasmania, 1881, p. 168; Cloudy Bay, South Bruni Island, and off Brown's River: Tate & May, Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 439, Text, fig. 12.

It was found by me in Guichen Bay, in a small sandy cove between two rocky prominences, which projected into the sea. Just beyond the margin of the receding wave it formed an abundant dark reddish-brown shifting sediment, with tiny fragments of brown seaweed. It was scooped up in hundreds with a spoon, mixed with *Philippiella crenatulifera*, Tate, and *Neolepton rostellatum*, Tate. It had not previously been recorded for South Australia. It was taken also in Lacepede Bay in numbers, and in small quantity at MacDonnell Bay.

Family MYTILIDÆ, D'Orbigny.

Genus Modiola, Larnarck.

M. linea, Hedley.

Modiola linea, Hedley, Records of the Austr. Mus., vol. vi., part 4, 1906, p. 300, pl. lvi., figs. 23, 24, 25.

Type loc.—80 fathoms off Narrabeen, New South Wales.

Dredged, 104 fathoms, 35 miles S.W. of Neptune Islands, 34 valves, 1 alive (Verco).

Family LEPTONIDÆ, Gray.

Genus Neolepton, Monterosato.

N. rostellatum, Tate.

Kellia rostellata, Tate, Trans. Roy. Soc. South Austr., 1888 (1889), vol. xi., p. 63, pl. xi., fig. 14. *Type loc.*, Port Phillip Heads, Victoria, dredged alive, 7 to 9 fathoms, attached to seaweed; Tate & May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., p. 432, King Island.

Neolepton rostellatum, Tate, Hedley, Pros. Linn. Soc. N.S. Wales, 1905 (1906), vol. xxx., part 4, p. 542, pl. xxxi., figs 3, 4.

Taken in numbers alive at the water's edge in Guichen Bay, also in shell-sand in Lacepede Bay, and at MacDonnell Bay. Not previously recorded for South Australia.

BRACHIOPODA.

Cryptopora brazieri, Crane.

Atretia brazieri, Crane, Proc. Zool. Soc., 1886, p. 183.

Cryptopora brazieri, Crane, Hedley, Proc. Linn. Soc. N.S. Wales, vol. xxxi., part 3, p. 467, pl. xxxvi., figs. 1, 2, "Common at 17 to 20 fathoms around Masthead Island, Queensland, on the polyzoan, *Selenaria maculata*, Busk."

Dredged 104 fathoms, 35 miles S.W. of Neptunes, 33 examples; 62 fathoms N.W. of Cape Borda (Verco).

PTEROPODA.

No Pteropods have hitherto been recorded from South Australian waters. The "Challenger," after leaving South Africa, worked in high southern latitudes, then made direct

for Melbourne, and dredged thence to Sydney. Several species belonging to this class were thus listed for the Victorian and New South Wales coasts, but none for South Australia. My dredgings during the last few years off the shores of South Australia have yielded seven species of Pteropods belonging to three different genera. The shallowest water in which they were taken was sixty-two fathoms. They were found at all intermediate depths down to 300 fathoms, which was the limit of my operations. No specimens were taken alive, but only their glass-like shells. I am indebted to Mr. C. Hedley, F.L.S., for their identification. "The Challenger Reports, vols. xix. and xxiii."; and "The Catalogue of Marine Shells of Australia and Tasmania, pt. 2, Pteropoda, by John Brazier, C.M.Z.S., F.L.S., Australian Museum, Sydney (Catalogue No. 15), 1892," will supply the synonymy of the species and their habitat.

Family LIMACINIDÆ, Gray.

Genus LIMACINA, Cuvier.

L. inflata, D'Orbigny.

Atlanta inflata, d'Orbigny, Voyage dans l'Amerique méridionale, vol. v., p. 174, pl. xii., figs. 16, 19, 1836.

Station.—62 fathoms, N.W. of Cape Borda, several; 104 fathoms, S.W. of Neptune Islands, many.

Family CAVOLINIIDÆ, D'Orbigny.

Genus CAVOLINA, Abildgaard.

C. trispinosa, Lesueur.

Hyalæa trispinosa, Lesueur, M.S., in de Blainville, Hyale, Dict. d. Sci. Nat., vol. xxii., p. 82, 1821.

Stations.—90 fathoms, off Cape Jaffa, 5 examples, 300 fathoms 10; 100 fathoms off Beachport 1, 110 fathoms several, 150 fathoms 2; 104 fathoms off the Neptunes, many.

C. tridentata, Forskäl.

Anomia tridentata, Forskäl, Descriptiones animalium quæ in itinere orientali observavit, p. 124, 1773.

Stations.—Off Beachport, 110 fathoms, several broken, 150 fathoms, 2 broken; off Cape Jaffa, 130 and 300 fathoms, at each one whole and a few broken; off the Neptunes, 104 fathoms, 2.

C. inflexa, Lesueur.

Hyalæa inflexa, Lesueur, Memoire sur quelques amimaux mollusques, etc., Nouv. Bull. Soc. Philom., vol. iii., p. 285, pl. iii., fig. 3, 1813.

Station.—Off Neptunes, 104 fathoms, 1.

Family CLIIDÆ.

Genus Clio, Browne.

C. subula, Quoy & Gaimard.

Cleodora subula, Quoy & Gaimard, Observations Zoologiques faites à bord de l'Astrolabe, Ann. d. Sci. Nat., Ser. 1, vol. x., p. 223, pl. viii., D, figs. 1, 3, 1827.

Stations.—62 fathoms, N.W. of Cape Borda, many; 104 fathoms, 35 miles S.W. of Neptunes, many; 130 fathoms, off Cape Jaffa, 6; 300 fathoms, off Cape Jaffa, very many.

C. pyramidata, Linné.

Clio pyramidata, Linné, Systema Naturæ, Ed. 12, p. 1094, 1767.

Stations.—90, 130, and 300 fathoms, off Cape Jaffa; 104 fathoms, 35 miles S.W. of Neptunes.

C. balantium, Rang.

Cleodora balantium, Rang, Magasin de Zoologie, 1834, pl. xliv.

Stations.—110 and 150 fathoms, off Beachport, several fragmentary; 130 and 200 fathoms, off Cape Jaffa, several fragmentary.

PELECYPODA.

Family CRASSATELLITIDÆ.

Genus Cyamiomactra, Bernard.

C. mactroides, Tate & May.

Cyamium mactroides, Tate & May, Trans. Roy. Soc. South Austr., 1900, vol. xxiv., p. 102. *Type locality*, Tasmania (W. F. Petterd); Tate & May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., part 3, p. 433, pl. xxvii., fig. 103.

Cyamiomactra mactroides, Tate & May, Hedley, Proc. Linn. Soc. N.S. Wales, 1905 (1906), vol. xxx., part 4, p. 541, pl. xxxi., figs. 9, 10, giving variations, figuring shell and hinge, and supplying additional localities, Victoria, N.S. Wales, and Queensland.

Taken in great numbers, alive and dead, in deep water, St. Vincent and Spencer Gulfs (Verco).

C. communis, Hedley.

Cyamiomactra communis, Hedley, Proc. Linn. Soc. N.S. Wales, 1905 (1906), vol. xxx., p. 541, pl. xxxi., figs. 11, 12, 13. *Type locality*—Manly Beach, near Sydney (Miss L. Parkes), Port Fairy, Victoria (Whan).

Found in numbers in shell-sand at MacDonnell Bay, and at Guichen Bay (Verco).

Genus CUNA, Hedley, 1902.

Cuna delta, Tate & May.

Carditella delta, Tate & May, Trans. Roy. Soc., S. Austr., vol. xxiv., 1900, p. 102. *Type locality*—Derwent Estuary, Tasmania (W. L. May); Hedley, Records Austr. Mus., vol. iv., No. 1, 1901, p. 23, figs. 5a, b, dredged off N.S. Wales, in 35 fathoms; Tate and May, Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 434, pl. xxvii., figs. 100, 101; *Cuna delta*, Tate & May, sp., Hedley, Memoirs Austr. Mus., vol. iv., part 5, 1902, p. 316.

Dredged in deep water, St. Vincent Gulf and Backstairs Passage, several alive and dead (Verco); Aldinga (Kimber).

C. concentrica, Hedley.

Cuna concentrica, Hedley, Memoirs Austr. Mus., vol. iv., 1902, p. 315, fig. 55. *Type locality*—Port Kembla, 63-75 fathoms; Hedley, Records Austr. Mus., vol. vi., part 2, 1905, p. 42, 111 fathoms, off N.S. Wales.

Dredged in 20 fathoms, Backstairs Passage, many examples (Verco).

Family CONDYLOCARDIIDÆ, Bernard.

Genus CONDYLOCARDIA, Bernard.

C. ovata, Hedley.

Condylocardia ovata, Hedley, Proc. Linn. Soc. N.S. Wales, 1905, part iv., vol. xxx., p. 539, pl. xxxi., figs. 5, 6. *Type locality* —Manly Beach, in shell sand (Miss L. Parkes).

St. Vincent Gulf, deep water, many complete and valves (Verco); identified by Hedley from his type.

C. trifoliata, Hedley.

Condylocardia trifoliata, Hedley, Moll. Masthead Reef, Queensland, part 1, Proc. Linn. Soc. N.S. Wales, 1906, vol. xxxi., part 3, p. 475, pl. xxxvii., figs. 20 to 23. *Type loc.*—Several alive from 17-20 fathoms. Also Middle Harbour, Sydney.

Many were obtained by me some years ago in dredge-siftings from Backstairs Passage and St. Vincent Gulf. Though so minute, less than 1½ mm., the young shells may be found within them.

Family VENERIDÆ.

Genus GAFRARIUM (CIRCE).

G. angasi, Smith.

Gouldia australis, Angas, Proc. Zool. Soc. Lond., 1865, p. 459; 1867, p. 928.

Circe australis, Angas, Smith, *op. cit.*, 1881, p. 491.

Circe angasi, Smith, Challenger Reports, Zool., vol. xiii., 1885, p. 148, pl. ii., figs. 4 to 4*e*. *Hab.*—Port Jackson, N.S. Wales, 2 to 10 fathoms.

Gafrarium angasi, Smith, Hedley, Moll. of Masthead Reef, Queensland, Proc. Linn. Soc. N.S. Wales, 1906, vol. xxxi., p. 466.

Dredged alive at 17 fathoms, St. Vincent Gulf and Backstairs Passage, 4; at 18 fathoms, Investigator Straits, one example; at 45 fathoms, east of Neptune Islands, 1, and 4 valves; at 17 and 22 fathoms, many valves; in Spencer Gulf, unrecorded depth, 1 alive, and 6 valves (Verco).

Var.—Only one individual of a pale tint has the typical radial rays; most shells are of a pinkish chestnut, especially at the umbos, disposed in dark and light concentric bands; some are deep reddish-brown at the umbos and along the post-dorsal and ventral margins, and have no concentric bands; others are white.

The Ionisation Curve of Methane.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and W. T. Cooke, D.Sc.

[Read June 4, 1907.]

It has been shown by one of us (Bragg, Phil. Mag., April, 1907) that the loss of energy experienced by the α particle in crossing an atom depends, in some cases at least, on the speed of the particle. When the atom is a heavy one there is rather more loss of energy at the higher speeds. This is true of aluminium, tin, silver, and gold, in comparison with each other and with air.

It was of some importance to determine whether the principle extended to gases also, and the great difference between the weights of the N and O atoms, on the one hand, and the H atom on the other, seemed likely to furnish a good opportunity of settling the question. The ranges of the various α particles in hydrogen itself were too long for the apparatus at our disposal. We therefore prepared some methane (CH_4), since this gas contains a large proportion of hydrogen, and has a convenient stopping-power. The details of the preparation are given below.

The accompanying figure shows the curve which was obtained as the result of the experiment. An air curve is also drawn in the figure so as to make it easy to compare the various ranges in the two gases. The pressure and temperature of the air were adjusted so that the ranges of the α particle from radium itself were the same in both.

It will be seen that the ranges of the other three α particles do not quite correspond. The more energetic particles go further in methane than in air: thus showing that the ratio of the stopping-power of methane to that of air increases somewhat as the speed of the particle diminishes. In other words, fast α particles are less stopped by methane than slow ones, if air is taken as the standard of comparison. This result agrees with, and is an extension of, the principle established in the paper already quoted.

It is interesting to see that, as a consequence, the four steps of the ionisation curve are more clearly shown in methane than in air; in particular, the portions due to RaA and the emanation are very well separated.

The stopping-power of methane, compared to air, is ·860 for RaC and ·880 for RaA. This seems to show that the stop-

ping-power of H is rather lower than the value previously given: but the exact determination depends on the value adopted for the carbon atom, which is at present the subject of investigation.

The total ionisation in methane was found to be 1·165 times greater than in air. Initial recombination effects were small, probably less than in air: experiments on this point are not yet complete.

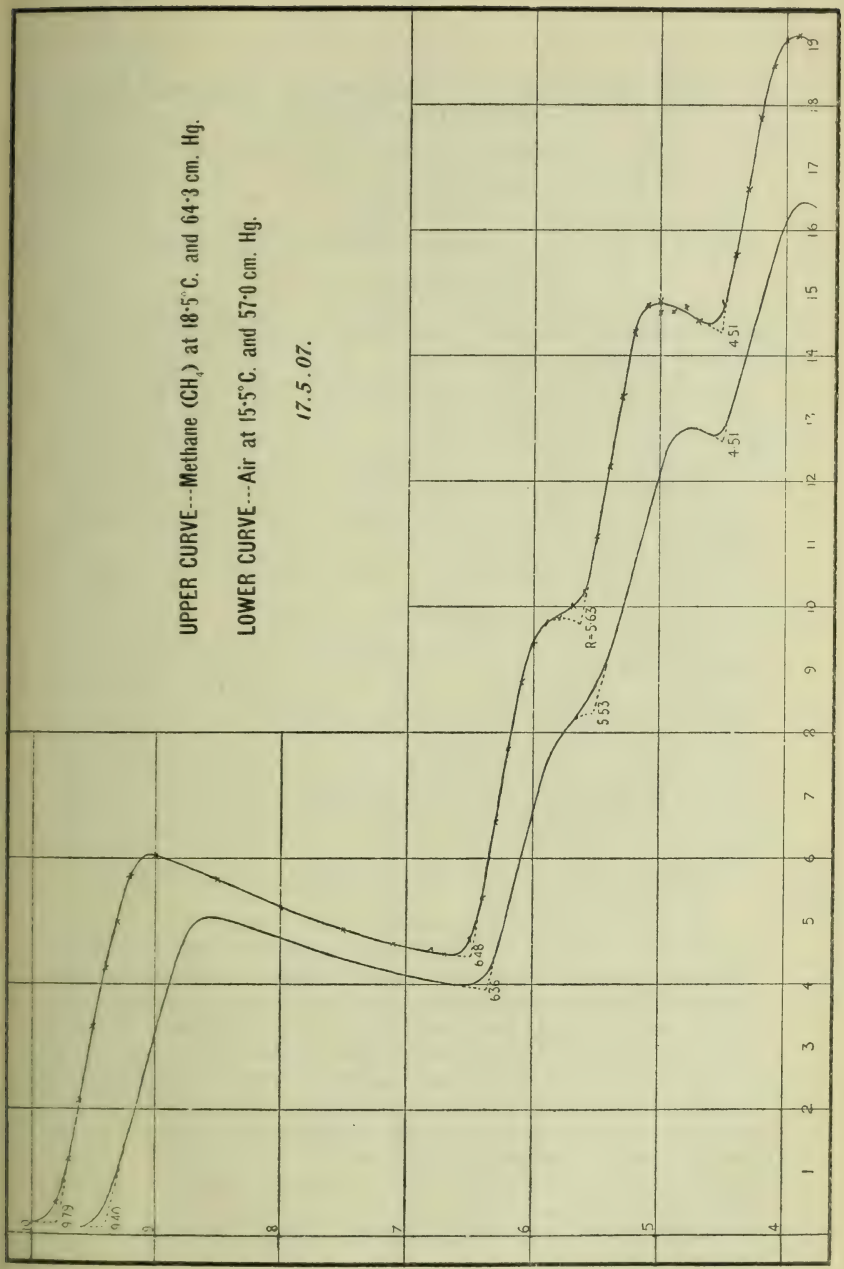
Preparation of the Methane.

The gas was prepared by acting on an aluminium-mercury couple with a mixture of methyl alcohol and methyl iodide, following the directions of Bone and Wheeler (J.C.S., Trans. 1902, 541). These authors freed the methane from the hydrogen present as an impurity by passing the gases over "oxidized" palladium warmed to 100° C. Charitschkaff, however, states (J.C.S., A ii., 1903, 186) that when a mixture of hydrogen and methane is passed over palladinized asbestos not only does the hydrogen burn, but also some methane.

In our experiment the gases issuing from the generator were passed first through two vessels immersed in alcohol which had been cooled to its freezing-point, roughly 160° T. This cooling served to condense the vapours of iodide and alcohol, and to remove also any higher hydrocarbons which might have been formed.

The mixture of methane and hydrogen passed secondly through two vessels cooled in liquid air. In these vessels the methane condensed to a colourless liquid, while the hydrogen passed on and was neglected.

After sufficient methane had liquefied, communication between the first and second pair of cooling vessels was cut off, and the methane allowed to evaporate into a mercury gasholder. The methane was then recondensed as far as possible by again cooling the vessels in liquid air. Part of the methane was then allowed to evaporate into the gasholder, and the gas coming off was pumped away. This partial evaporation was repeated, and a second portion of gas removed. In this way the hydrogen remaining in the connecting tubes, or dissolved in the methane, was removed. The methane remaining showed a vapour pressure of about 150 mm. of mercury. As far as can be gathered from the figures available, this pressure corresponds to that given by methane at the temperature of liquid air, say 90° T. Evidently the gas was quite pure. A determination of its density gave the value ·552, taking air as unity. This figure is almost identical with the calculated value, which is ·553.


UPPER CURVE---Methane (CH_4) at 18·5° C. and 64·3 cm. Hg.
LOWER CURVE---Air at 15·5° C. and 57·0 cm. Hg.
17.5.07.
9·73
9·40
6·48
6·36
R=5·63
5·53
4·51
4·51

New Species and Genera of Australian Lepidoptera.—No. XXIII.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read May 7, 1907.]

TINEINA.

ŒCOPHORIDÆ.

Eochrois leiochroa, n. sp.

Male, 18 mm. Head, palpi, antennæ, and thorax dull white, patagia ochreous. Abdomen greyish-ochreous. Legs whitish, posterior pair ochreous. Forewings elongate, moderate, costa gently arched, apex pointed, termen gently bowed; pale ochreous, minutely irrorated with fuscous; a broad fuscous supra median streak from base to apex, edges suffused; ground-colour between upper edge and costa somewhat orange tinted, especially on basal third; cilia pale orange-yellow, terminal edge blackish. Hindwings grey; cilia grey-ochreous, becoming yellowish at base.

Townsville, Queensland. Two specimens; in October. (Dodd.)

Eochrois trisema, n. sp.

Female, 20 mm. Head, palpi, antennæ, and thorax yellowish. Abdomen greyish. Legs dull whitish. Forewings elongate, moderate, costa gently arched, apex obtuse, termen oblique; pale yellow, somewhat mixed with fuscous, sometimes clear yellow; markings obscure, formed by coalescence of fuscous; 3 spots at $\frac{1}{4}$, middle, and end of cell; sometimes first two absent; apical area of wing darker than rest. Cilia ochreous-fuscous. Hindwings pale grey or greyish-ochreous; cilia ochreous.

Mackay, Queensland. One specimen; without date.

Eulechria paraleuca, n. sp.

Female, 28 mm. Head, palpi, and thorax dull white. Abdomen greyish-ochreous. Legs whitish, posterior pair yellowish. Forewings elongate, costa gently arched, apex rounded, termen obliquely rounded; white, faintly suffused with fuscous, leaving costal edge clear white; a black dot in disc at $\frac{1}{3}$; a second, elongate, below and slightly beyond; a third resting on upper edge of cell beyond middle; a suffused fuscous spot at posterior end of cell, veins towards termen more or less outlined with fuscous; cilia yellow.

Hoyleton, South Australia; Broken Hill, New South Wales. In November.

One of the long-winged species, recalling *Nephogenes* in general appearance.

EULECHRIA MONODA, n. sp.

Female, 19 mm. Head, palpi, antennæ, and thorax fuscous. Abdomen and legs fuscous. Forewings elongate, moderate, costa gently arched, termen oblique; whitish, mixed with grey, markings obsolete in most specimens, but where distinguishable consist of a fuscous spot at $\frac{1}{3}$, a second just above, and two others at end of cell, sometimes confluent; cilia greyish. Hindwings greyish, tinged with ochreous; cilia grey.

North Queensland. One specimen; taken in December.

ŒNOCHRODES, n. g.

Head with appressed hairs, sidetufts moderate. Antennal ciliation 1, moderately and evenly ciliated, with pecten. Palpi moderate, second joint nearly reaching base of antennæ, roughly haired, but not forming a definite tuft. Thorax with a moderate posterior crest. Forewings elongate, moderate, vein 7 and 8 stalked, 7 to apex, 2 almost from angle of cell. Hindwings about 1, 3 and 4 widely remote at origin. Hairs of posterior tibiæ very long. Near *Œnochroa*, Meyr., to which it is somewhat allied by the remoteness of veins 3 and 4 of hindwings, and from *Eulechria* by the tufted thorax; some species of *Eulechria* have veins 3 and 4 of hindwings tolerably remote at origin, at all events not stalked, but this character often occurs in the same species, in fact, in one specimen of *E. œdoxella* I have, one wing has 3 and 4 stalked and remote at origin in the other.

ŒNOCHRODES CROSSOXANTHA, n. sp.

Female, 22 m.m. Head, palpi, antennæ, and thorax ashy-grey-fuscous. Legs fuscous, posterior pair yellow. Forewings elongate, moderate, costa gently arched, ashy-grey-whitish, mixed with fine fuscous scales; markings black; a dot on fold at $\frac{1}{3}$ from base; a second, just above and slightly before; a third in middle, lying on upper edge of cell; a curved somewhat lunate mark at end of cell; a moderate thick line from costa at $\frac{5}{6}$ to dorsum at $\frac{5}{6}$ indented beneath costa, thence curved to termination, where it becomes more distinct; a suffused row of marks along termen; cilia ashy-grey-whitish. Hindwings rather pointed at apex; light fuscous; cilia yellow.

Male, 20 mm. Head, palpi, antennæ, legs, and thorax dark fuscous, posterior legs as in female. Antennal ciliations 1. Forewings shaped as in female; dark fuscous with a few dull whitish scales; all markings obscured through general ground-colour; cilia grey-whitish, at base thickly sprinkled with fuscous. Hindwings as in female.

Hoyleton, South Australia. Four specimens; in December.

NEPHOGENES DROSERODES, n. sp.

Female, 20 mm. Head, palpi, antennæ, thorax, and abdomen dark fuscous, head and thorax minutely sprinkled with whitish. Legs dark fuscous, anterior and middle coxæ sprinkled with whitish scales. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; dark fuscous, minutely irrorated with whitish scales throughout; markings black, rather obscure; a moderately large fascia-like spot from just beneath costa before middle reaching to just beyond fold; a moderate erect spot from anal angle, reaching $\frac{2}{3}$ across wing, broadest at base; a spot on costa at $\frac{4}{5}$, from which is emitted a curved mark which meets previous spot at anal angle; cilia dark fuscous, mixed with darker and with a few whitish points. Hindwings and cilia dark fuscous, somewhat bronzy-tinged.

Broken Hill, New South Wales. One specimen; in August.

NEPHOGENES DRYMELANTHES, n. sp.

Male, 14 mm. Head and thorax white. Palpi and antennæ whitish, second joint of palpi fuscous externally. Abdomen greyish, legs fuscous, posterior pair whitish. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; white suffused on margins with pale fuscous, and with ochreous fuscous markings; a moderately large spot on fold, from base to quarter a small spot at posterior extremity of this, almost confluent; an irregular ovoid spot in posterior end of cell, nearly confluent with previous spot; a round spot just beyond end of cell, from which proceeds a curved series of dots going towards termen, forming a more or less irregular indistinct ovate mark; a spot at anal angle; cilia grey-whitish. Hindwings and cilia grey.

Broken Hill, New South Wales. Two specimens; in April.

NEPHOGENES PYCNODA, n. sp.

Male, female, 20-28 mm. Head, palpi, thorax, antennæ, and legs ashy-grey-whitish, posterior legs greyish. Abdomen dull ochreous-grey. Forewings rather broad, costa gently arched, apex rounded, termen obliquely rounded; ashy-grey-whitish; markings dark fuscous; an obscure mark and costa near base, more or less continued to dorsum; a double dot, transversely placed, sometimes confluent at end of cell; a spot on upper edge of cell; a similar one, in a line with previous dots, at extremity; lower and posterior edge of cell outlined with dark fuscous, sometimes divided into three elongate spots; a line from $\frac{5}{6}$ costa to dorsum before anal angle, indented beneath costa, thence curved around to termination; a row of obscure spots along termen; cilia ashy-grey-whitish. Hind-

wings greyish-ochreous; cilia greyish-ochreous, with a fuscous sub-basal line.

North Queensland. Two specimens; in October.

NEPHOGENES AMPHISEMA, n. sp.

Male, 18 mm. Head, palpi, antennæ, and thorax ashy-grey-fuscous. Abdomen and legs greyish. Forewings elongate, moderate. Costa gently arched, termen rounded, oblique; ashy-grey-whitish; a small elongate black spot on fold in middle; a similar one above and beyond, and a third in middle of wing at $\frac{2}{3}$, each dot surrounded by an irregular ring of dull whitish in the first two, more or less confluent; in the third, becoming somewhat fascia-like; cilia dull fuscous. Hindwings and cilia fuscous.

North Queensland. Several specimens; in December; frequenting grass.

PHILOBOTA DASYCOPA, n. sp.

Female, 15 mm. Head and palpi white. Thorax fuscous, patagia. Antennæ fuscous. Abdomen ochreous. Legs ochreous, anterior pair fuscous. Forewings elongate, moderate, costa gently arched, termen rounded, oblique; white, with fuscous markings; an S-shaped mark, commencing from dorsum near base, thence curved up towards costa and around to fold at $\frac{1}{4}$, and continued along it for a short distance, and curved up at extremity, whence it meets a broad, irregular-edged lighter fuscous transverse fascia, whitish-edged, from costa at $\frac{2}{3}$ to dorsum at anal angle; a short, inwardly oblique, transverse fascia from costa at $\frac{5}{6}$ to termen at anal angle, with a darker fuscous spot on its anterior edge above middle; cilia white, with a broad fuscous tooth below middle. Hindwings greyish-fuscous; cilia greyish-ochreous, fuscous tinged at base.

MacDonnell Bay, South Australia. One specimen; in December.

PHILOBOTA SPHENOLEUCA, n. sp.

Male, 20 mm. Head snow-white. Palpi fuscous, termination of second joint white. Antennæ fuscous, faintly irrorated with white. Thorax whitish, patagia brownish. Legs fuscous, sprinkled with whitish; posterior tibiæ ochreous. Abdomen dull whitish. Forewings elongate, moderate, costa gently arched, termen oblique; white, becoming broadly fuscous along dorsum; markings fuscous; a well-marked streak from costa at base, continued along fold to near middle, with a sharp projection near costa; a lunate mark at posterior extremity of streak, almost confluent with it; a thick suffused streak along costa from $\frac{1}{6}$ to $\frac{3}{4}$, both extremities pointed; a strong, inwardly oblique streak from $\frac{5}{6}$ costa to beyond middle of wing, preceded above middle by a minute black dot; wing beyond this irrorated with fuscous; a suffused row of dots

along termen; cilia greyish-ochreous. Hindwings greyish; cilia pale greyish ochreous, with a fuscous basal line.

Balaklava, South Australia. One specimen; in September.

Cæsyra platyxantha, n. sp.

Male, female, 12-14 mm. Head yellow. Thorax dark coppery-fuscous. Palpi pale ochreous. Antennæ dark fuscous, faintly annulated with whitish. Abdomen and legs dark fuscous, posterior pair mixed with ochreous. Forewings elongate, moderate, costa gently arched, termen oblique, slightly bowed; bright yellow; a dark purplish basal patch, hardly reaching dorsum, very shortly continued along costa; a broad bright reddish-purple band along termen, anteriorly edged with a waved nearly straight line, posterior edge with a fuscous suffusion at apex; cilia bright yellow, becoming fuscous at tornus. Hindwings bronzy-fuscous; cilia fuscous.

Perth, Western Australia. Three specimens in November (Addis).

Ocystola agramma.

Female, 10 m.m. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous. Forewings elongate, rather narrow, termen very oblique; pale whitish ochreous, without markings; cilia pale whitish-ochreous. Hindwings pale grey-whitish; cilia grey-whitish.

North Queensland. One specimen; in December.

Blastobasis anthoptera, n. sp.

Male, 12 mm. Head, palpi, and thorax pale ochreous. Abdomen and legs pale ochreous. Forewings elongate, moderate, costa nearly straight; apex round-pointed; pale ochreous, markings fuscous; a mark at base on costa; a minute dot in middle of wing; two small spots, placed one above the other, beyond posterior extremity of cell; a row of elongate marks along termen and apical fifth of costa; cilia pale ochreous. Hindwings ochreous-fuscous; cilia grey, with a pale fuscous sub-basal line.

Townsville, Queensland. One specimen; at light.

Blastobasis monozona, n. sp.

Male, 12 mm. Head, palpi, and thorax fuscous. Abdomen and legs grey, segmental margins of abdomen dull silvery-white. Forewings elongate moderate, costa hardly arched, apex pointed; light fuscous, with a few whitish scales; a short fuscous basal fascia; an irregular fuscous fascia from just beyond $\frac{1}{3}$ costa to dorsum at $\frac{1}{3}$, internally edged by its own width of white; ground colour between this and base ochreous-tinged; a row of fuscous dots along termen and apical fifth of costa; cilia fuscous. Slightly ochreous-tinged at base. Hindwings light ochreous; cilia greyish, base ochreous-grey.

North Queensland. One specimen; in December.

Mineralogical Notes.

By D. Mawson, B.E., B.Sc.

[Read May 7, 1907.]

Plate XXI.

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I. Barytes Sand Crystals.

Crystalline sandy nodules occur shoaded on the surface above the cliffs immediately north of Hallett Cove. Their occurrence has long been known, though their composition is generally stated in local collections as "pseudomorphs after selenite."

On first encountering these crystals, the author was struck by their high specific gravity; chemical tests were therefore instituted, and an analysis showed a typical individual to contain approximately 35 per cent. of barium sulphate.

Further investigations revealed its presence, as optically continuous barytes, cementing the remaining 65 per cent., which is composed of ordinary sand grains. Calcium sulphate was found present only in negligibly small quantity.

The aggregates prove, therefore, to be "barytes sand crystals," analogous to the well-known "calcite sand crystals" from Indian Reserve, United States of America.

The exact location of the occurrence is above the cliffs at Black Point, and for some eight chains northward, following near the lower margin of the Miocene limestone. A very complete geological section at Black Point is detailed in one of the Aust. Ass. Adv. Science Glacial Research Committee Reports.[1] A considerable thickness of alternating rusty and yellowish sandy, and chocolate and reddish shaly beds are there shown to compose the upward extension of the Permo-

(1) Pl. i., — Brisbane, 1895.

carboniferous glacial beds, and to be overlain unconformably by the Miocene sandy limestone.

It is in one of the uppermost yellowish sandy horizons of the glacial beds that the barytes sand crystals occur. The particular bed is only a few inches in thickness, and weathers into soft, friable sand-rock, with hard nodular barytes aggregates distributed plentifully throughout.

Specimens were collected from the associated beds, and tested for sulphate. Contrary to expectation, none was found present, though other characters of the beds are evidence of their epirogenic formation under arid conditions; possibly gypsum was present formerly and has since been removed.

Several of the sandy beds were found to be firmly cemented by a calcite cement in optical continuity, and represent, therefore, a massive form of *Fontainebleau Sandstone*.

The typical form of the "barytes sand crystals" is in bunched aggregates averaging 3 cms. diameter. Various intermediate stages are well represented. Sharp crystal edges are never developed, even on specimens collected *in situ*. Single individuals are flat, tabular forms, with edges rounded. Divergent groups of three or four individuals, having the *b* axis in common, are most usual (c.f. pl. xxi. fig. 3.) In cases where a large number have thus grown together, especially when, as in more complicated groups, cross-growths enter into the aggregate, the fully-developed form, with surface resembling peach-stone corrugations, is produced (c.f. pl. xxi. fig. 4).

II. Radial-Nodular Barytes.

Specimens of an unusual form of Barytes collected in the Brighton Lower-Cambrian limestone quarries were, several years ago, presented to the University by Professor E. H. Rennie.

The barytes nodules are as much as 12 cms. in diameter, with a somewhat irregular smooth exterior, occasionally marked by growth lines; interiorly, a radial arrangement is evidenced. The mineral is dark-brown in colour, transparent, and has a vitreous lustre; hardness, about 3·2; fracture, conchoidal.

Some of the specimens pass outwards into a yellowish-white opaque radial curvilaminar form, with silky lustre. A qualitative analysis showed the mineral to be nearly pure barytes.

III. Gypsum from Southern Yorke Peninsula.

Three varieties of gypsum are found genetically connected with the salt lakes of Southern Yorke Peninsula. The following details concerning these occurrences may be of interest,

as they have not previously been accorded their due importance in scientific literature.

Crystal Gypsum.—Gypsum is found in large clear tabular forms, as much as three inches in diameter, very generally occurring in the saline mud below the salt crust of the lakes. The individuals are often separate and are well-formed. The {111} form is always well-developed, and the crystal closed by uneven planes, approximately in the position of the {001} form. No other faces were observed. The individuals are therefore much flattened in the vertical direction. They occur set in the mud, with the tabular dimensions fairly regularly horizontal. The specimens examined contain only slight inclusions of foreign matter.

Seed Gypsum.—What is locally designated by this name attains a wonderful development, notably along the south side of Lake Fowler. There, some distance in from the original lake boundary, an immense dune about one mile in length, and as much as 30 feet in height and 50 yards in breadth, is formed exclusively of this substance.

The grains are seed-like, and average 0·25 cm. long, and about one-third of this amount in diameter. Only sufficient impurity is present to impart to it a slight yellowish tint. The whole mass, throughout the dune, is readily friable. Scant vegetation exists along the ridge.

With regard to the origin of this deposit, it must, undoubtedly, have been heaped up by hot dry northerly summer winds, sweeping before them the small particles, chiefly cleavage fragments, of gypsum from off the saline crust of the lake.

"Decompo."—The third variety forms a surface zone over the seed gypsum; it is much whiter than the latter, and is in the form of an extremely finely-crystalline powder. Qualitatively tested, it proved to be composed of calcium sulphate, with a very small quantity of calcium carbonate admixed. The local term is a contraction of decomposed, as it is regarded to have originated from the decomposition of other forms of gypsum.

Correctly speaking, this is not a decomposition product, but has resulted from solution and re-precipitation of previously-existing gypsum by surface percolating waters. This explanation accounts for the widely-varying thickness of the zone, from a few inches to several feet and even more where an easy passage for descending waters has been available.

Though the present market does not allow of more than desultory exploitation of the Yorke Peninsula gypsum, these enormous deposits, conveniently situated and easily won, must ever be an increasingly valuable asset to the State.

IV. Gypsum from the Patawalonga Creek.

Several years ago Mr. W. Howchin [2] exhibited crystals of gypsum from a locality near Glenelg. The following are additional remarks on material collected recently, during a combined visit to that locality. The spot is about one mile beyond the Patawalonga Creek, and close to the Glenelg to Reedbeds Road. The ground is there low-lying, elevated only a few feet above sea-level, and consequently swampy in wet weather. Gypsum crystals are met with abundantly, set in the soil a few inches below the surface. Deeper down, they are interwoven together, and set in a shelly mud, evidently a recently raised estuarine mud-bank.

We excavated to a depth of about 3 feet, and the gypsum formation was there as well developed as above.

The specimens saved for examination are, in general, bunched aggregates of interpenetrating tabular crystal masses; the units commonly attain lateral dimensions of 12 cms. by 8 cms. There is a marked tendency to radial twinning on the *b* axis. Crystal faces are not defined, but represented by drusy curved outlines. The drusy character of the surface is due to the development of very numerous independent similarly-oriental crystal growths. These latter are of lenticular form, bounded by smooth rounded outlines, and have resulted from the exclusive development and rounding off of the {111} and {$\bar{1}$03} forms. Inclusions, usually shells and shell fragments, are abundant. In fact, the major portion of the occurrence exposed varied between gypsum beds containing little residual shell matter, and shell beds with occasional development of enveloping ramifying gypsum crystals; in the latter case the crystallographic continuity is not affected by the foreign shell-matter.

Crystals occurring in the topmost layers, near the surface of the ground, are somewhat differently modified. In this upper zone the matrix is sandy, and almost free from calcium carbonate; foreign included matter in the gypsum consists, therefore, chiefly of sand grains, which may occupy a large bulk in the crystallization. The crystal aggregates themselves are much smaller, more compact, smoother surfaced, and represent simpler combinations.

The simplest individual is identical in character with the lenticular growths contributing the drusy character to the larger crystals already described: they are, however, much larger, some obtained measuring 5 cms. diameter. The lenticular form tends towards a somewhat irregular dumpy bicone. Twinning is almost universal, and frequently a num-

[2] Trans. Roy. Soc., S. Australia, vol xxvii., pt. ii., p. 311.

ber of twinned individuals combine to form crystal aggregates. Interpenetrant twins on the *a* face are usually developed. Two forms effected by this type of twinning are figured. The flat upper faces appearing in pl. xxi., fig. 1, are of the $\{\bar{1}03\}$ form ; the faces below, shown in fig. 1*a*, are of the $\{111\}$ form.

The spiral type (fig. 2) is very commonly occurring ; it is the normal type modified by distortion due to unequal lateral development during growth.

The origin of the gypsum is, no doubt, due to the action of soluble sulphates on the calcium carbonate of the shell beds. The topmost horizon in the sandy matrix is thought to owe its location mainly to capillary attraction, due to surface evaporation, drawing the calcium sulphate in solution upward from below.

V. Gypseous Tufa.

Locality, near Grampus Dam, 12 miles south-east of Paratoo siding.

At this spot, on the flat ground stretching towards the bed of the creek, is exposed a surface deposit of white to yellowish friable material, ascertained to be composed of gypsum admixed with a considerable quantity of calcium carbonate. The area covered exceeds an acre, and the depth in places not less than 6 feet.

VI. Amazonstone.

Some fair specimens of amazonstone were recently got at a small copper-mine at Mulga Hill [3] in the Olary district ; they do not, however, compare with the better-known material from Broken Hill.

The ore-formation at the locality cited is associated with a coarse granitic pegmatite in highly-metamorphic rocks of the Lower-Cambrian or Pre-Cambrian age.

VII. Stolzite.

Well-crystallized specimens of stolzite occur in vughs in the oxidized portion of a galena lode situated about 17 miles east of Olary, and one mile south of the Luxemburg Mine. The crystals vary in colour from light honey-yellow to somewhat reddish. Molybdic acid was found in the latter variety, indicating an approach towards wulfenite.

VIII. Chrysotile.

Fine specimens of chrysotile, the silky fibrous form of serpentine resembling asbestos, may be obtained in the highly metamorphic Pre-Cambrian (?) marble belt near Tumby Bay, Eyre Peninsula.

---

[3] Mulga Hill is some six miles south-east of the Luxemburg Copper-mine.

The best accessible outcrop is on the property of the Port Lincoln Copper-mine, in the hills five miles west-north-west of the township. There the mineral occurs in fissures up to 5 cms. wide, traversing the marble. These chrysotile veins are set in massive yellowish-green serpentine, which grades outwards into the less metamorphosed marble, and evidently, originally, the sites of cracks, probably the effect of shattering by mechanical compression, or possibly arising from contraction consequent on dolomitization and other chemical changes effected in the originally pure limestone.

IX. Wollastonite.

So far as I am aware, this mineral has not previously been recorded from South Australia. It is extensively developed as an alteration product of the ancient marble referred to in the preceding paragraph.

The workings of the Port Lincoln Copper-mine are chiefly confined to a mineralized belt in this marble, and the ore gangue is largely composed of wollastonite.

As the rock is compact, crystals of the calcium-metasilicate cannot be readily isolated; nor does its pure white colour aid in discriminating it amongst other minerals present similar in this respect.

A number of microscope sections prepared of the rock, however, revealed its presence in varying proportions. By judicious selection, masses of almost pure wollastonite rock may be got.

The resistance to weathering offered by wollastonite allows of its ready detection on the exposed surface of the silicated marble, as where it occurs the weathered surface is rough and jagged.

Mineralogical Laboratory,
University of Adelaide.

EXPLANATION OF PLATE XXI.

Fig. 1. A lenticular gypsum twin, as found occurring in the subsoil near Glenelg.

Fig. 1*a*. View of same perpendicular to Fig. 1.

Fig. 2. A spiral twin of gypsum; a common development of preceding type.

Fig. 2*a*. View of same perpendicular to Fig. 2.

Fig. 3. A barytes sand crystal from Hallett Cove. Radial-tabular aggregates composed of sand grains cemented by about 35 per cent. of barytes.

Fig. 3*a*. View of same perpendicular to Fig. 3.

Fig. 4. A barytes sand-crystal as frequently developed at Hallett Cove, produced by multiplication of the number of individuals, contributing to the aggregates, and resulting in an ellipsoidal form, with corrugated surface, resembling a peach-stone.

Fig. 4a. View of same perpendicular to Fig. 4.

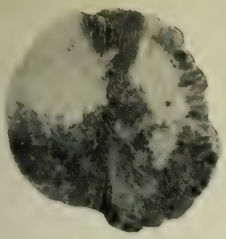

Fig. 1.

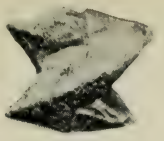

Fig. 2.

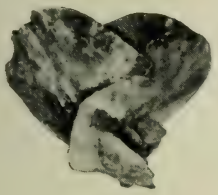

Fig. 1a.

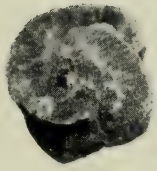

Fig. 2a.

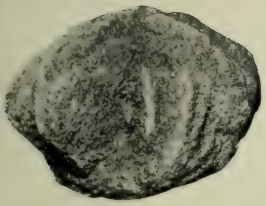

Fig. 3.

Fig. 4.

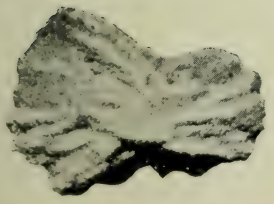

Fig. 3a.

Fig. 4a.

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Figs. 1 and 2.—Twinned Gypsum Crystals from Patawalonga Creek ; two-thirds natural size.

Figs. 3 and 4.—Barytes Sand Crystals from Hallett Cove ; natural size.

Three Species of Orchid hitherto Unrecorded in this State.

By R. S. Rogers, M.A., M.D.

[Read June 4, 1907.]

Plate XXII.

I.—**Thelymitra venosa** (R.Br.).

This orchid was discovered for the first time in South Australia on December 19, 1906, at Myponga, and on the following day at Square Waterhole, by Mrs. R. S. Rogers. So far it has reached me from no other districts. New South Wales is the only Australian habitat mentioned in Von Mueller's "Census" and in Bentham's "Flora Australia," although I have in my collection specimens of this plant collected by W. H. Archer in Tasmania in the early part of last century.

Description.

Height 11 to 30 inches. Stem not robust, and rather sinuous.

Leaf usually about two-thirds length of plant; linear, channelled.

Bracts, two acuminate, and a third subtending each flower.

Flowers 1-5, pediculated: Perianth segments rather thin and veined, especially the inner ones. The outer segments are rather longer than the inner.

Column winged, middle lobe not produced above the anther. Lateral appendages erect, rather blunt, spirally involute, not tufted.

Anther case very protuberant, with bifid apex, which reaches to about the same level as the lateral appendages.

Stigma bicusped.

Found growing in, or on the margin of, water, in swampy country.

II.—**Pterostylis furcata** (Lindl.).

Mr. J. M. Black recently handed to me for identification an orchid collected in January, 1907, near Karatta Station, Kangaroo Island. This proved to be *P. furcata*, a species of which no very satisfactory description seems to exist. I therefore think it advisable to describe this plant with considerable detail, and to produce drawings of plants in my possession collected by R. C. Gunn (Tasmania), and bearing date 5.11.1843. Bentham gives Tasmania as a habitat, and Victoria as a

doubtful habitat. In a note he adds: "Some specimens from Plenty Range, F. Mueller, seem referable to this species rather than to *P. cucullata.*"

F. von Mueller regards it as a variety of *P. cucullata.*

Rodway, in his "Flora of Tasmania," seems to have fallen into a curious error in supposing that this species is figured in Hooker's "Flora Tasmanica" as *P. pedunculata.* This figure, with its sessile basal leaves and small flowers, is certainly not meant to represent *P. furcata;* although, on the other hand, it is not a faithful picture of *P. pedunculata.* (The points of differential diagnosis will be dealt with later.) This plant certainly occurs in Victoria, as in January of this year I had forwarded to me several specimens from Cockatoo Creek, near Fern Tree Gully, Victoria.

Botanical Description.

Plant from 6 to 10 inches high.

Basal leaves shortly petiolate; 3-5 in number; ovate to lanceolate-ovate; margin entire.

Bracts large, leaf-like, loosely sheathing. Often 1 inch to $1\frac{1}{2}$ inches long. Usually two or three in number.

Flower solitary, erect; $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long.

Galea markedly beaked.

Lower lip erect, including rather an acute sinus; with long filamentous or narrow linear points embracing the galea, which they exceed in height.

Labellum oblong-linear, rather wider at the base than at the point, which is narrowly obtuse. For the greater part of its length it occupies a vertical position, but is gently recurved in its distal fourth. It is reddish-brown in colour, not twisted, has a raised mesial longitudinal line, and does not protrude through the sinus. Its basal appendage is curved, with a bifid tuft at its extremity.

The *column* is much shorter than the labellum, with a short subulate process from the upper angle of the wing.

The *stigmatic surface* is elliptical, and occupies rather more than the middle third of the column.

Differential Diagnosis.

(a) P. pedunculata (Br.) Basal leaves are wider, more obtuse, and have much longer petioles. Bracts scale-like and closely-sheathing. Flowers much smaller, rarely more than $\frac{3}{4}$-inch long. *Column is longer than labellum.* The labellum is almost elliptical.

(b) P. curta (Br.) Basal leaves larger, much broader, and more obtuse. Bracts larger than in *pedunculata,* but small when compared with *furcata. Inferior sepals acuminate*

and shorter than galea. Labellum always *twisted*, and protruded through sinus. Column at least as long as labellum.

(c) P. cucullata (Br.) Leaves and bracts much larger, more crowded, and sessile. The upper bract is very large, and partially envelopes the flower. *Points of lower sepals acuminate, incurved, and not longer than galea*. Column longer than labellum. Labellum narrow at base, widening into a broad blunt extremity.

P. pedunculata, *curta*, and *cucullata* begin to bloom in this State in August, and it is unlikely that even the latest blooms will extend into November. They represent three such distinct types that it is difficult to understand how any confusion can have arisen between them and *furcata*, and, in particular, how the latter can have been regarded as a variety of *cucullata*.

(d) P. acuminata (R.Br.) This is a New South Wales species. It blooms in April, after the early rains, and this alone suffices to distinguish it from *furcata*. The bracts are small and sheathing, the lobes of the lower lip are wider and more lanceolate than in *furcata*, and the labellum projects through the sinus.

The time of blooming of *P. furcata* may be placed at November to January.

III.—**Caleana major** (R.Br.).

This species has an interesting history so far as this State is concerned. It was not known to occur here until December, 1901, when a single specimen was discovered by Mr. T. A. Wilson at Mylor. This specimen is now in Mr. Tepper's collection. Although diligent search was made for further examples of this species it was fruitless until the end of November, 1906, when Mr. E. H. Lock found a few more specimens on Mount Lofty. Just a month later a very large number of specimens were collected for me at Dingabledinga (near Willunga) by a resident of that place. It may therefore now be placed confidently among the native orchids of this State.

Description.

Plant varies from 7 to 12 inches high.

Flowers, one or two, reversed, reddish-brown.

Leaf solitary, 2 to 3 inches long, slightly sheathing at the base, narrow-lanceolate, glabrous, generally reddish, with very distinct mid-rib.

Stem green or reddish-brown, wiry, with one tightly-sheathing bract a little above the insertion of the leaf, and another subtending each flower.

Dorsal sepal about $\frac{3}{4}$-inch long, incurved, narrowly concave, lanceolate.

Lateral sepals rather longer than the dorsal, usually slightly divergent, dentate about the middle, beyond which they are narrowly tubular and pointed. Proximal half narrow and channelled.

Lateral petals filiform, rather shorter than dorsal sepal.

Column incurved, almost as long as the dorsal sepal, very widely winged from below the anther. Wings fitted.

Stigmatic surface circular, just below the anther.

The winged column forms a vessel shaped somewhat like an ancient Roman lamp, which is capable of being almost completely closed by the labellum when this is lowered.

The *labellum* is attached to a long semi-circular strap-like claw. It consists of a rather large convex central lobe, about 3 lines in diameter, with a beak-like process looking towards the anther, and a shorter curved process looking towards the insertion of the lateral sepals. It is not so sensitive as the labellum in many of the genus *pterostylis*, but if a slight pressure be applied to the beak when it is in the raised position this will flatten itself against the claw, and the whole apparatus make a slow and deliberate descent so as to form a lid to the winged column.

DESCRIPTION OF PLATE XXII.

A. Pressed specimen from R. C. Gunn's collection of Tasmanian orchids (1843).

B. Shows column *(c)*, labellum *(l)*, anther *(a)*, pencillate appendage of labellum *(ap)*. All natural size.

C. Enlargement (x 3) of B.

Hussey & Gillingham, Printers, Adelaide.

Descriptions of Australian Curculionidæ, with Notes on Previously Described Species.

By Arthur M. Lea.

Part V.

[Read July 2, 1907.]

SUB-FAMILY LEPTOPSIDES.

Mandalotus.

Erichson referred this genus to the *Otiorhynchides* near *Tyloderes;* Lacordaire questioned its position there, but as it was unknown to him could not satisfactorily place it, and provisionally placed it at the end of the *Eremnides;* Pascoe referred *Dysostines* (a synonym of *Mandalotus)* to the *Rhyparosomides.* I believe the correct position of the genus to be in the *Leptopsides,* close to *Polyphrades.*

The eyes, the scrobes, and the triangular plate at apex of rostrum are very similar to those of most species of *Polyphrades,* as are also the loose way the four front coxæ are inserted, the shape of the side-pieces of the meso- and metasternum, and the transverse corrugations of the concealed part of the base of the head. The sexes also differ in much the same way.

The peculiar round, flattened granules of the prothorax are much the same as in many species of *Essolithna,* which genus is certainly very close to *Polyphrades.*

Many of the species have also a subtubercular elevation just behind the front coxæ, as in the species of *Leptops* and other genera of the *Leptopsides,* but it is often partially concealed.

The scrobes are slightly variable, but their shape is so often partially concealed by clothing that they cannot be satisfactorily used. Above each scrobe, towards the base, there is usually, if not always, a groove (sublateral sulcus) as in the species of *Leptops,* but this also is partly or entirely concealed by clothing.

The ocular lobes are distinct [1] and are always ciliated, but they are usually not so strong as in *Polyphrades.* The rostrum is slightly longer than in most species of that genus; but apart from this and the entirely free claws of *Mandalotus* it would be often difficult or impossible to distinguish the two genera.

[1] In *pilosus* and *pinguis* these lobes are absent; but, as will be noted below, these species belong to *Timareta.*

The antennæ are seldom of use for description; they differ somewhat in thickness, but the basal joints of the funicle are always longer than the others, and the first nearly always longer than the second; from some directions, however, the second often appears to be longer than, or at least as long as, the first.

The scutellum, when present, is always small, but it is so frequently either quite absent or concealed by scales and mud, that it is not a feature to be relied upon. It sometimes appears to be present, moreover, even when really absent; this being due to scales or mud becoming compacted at its position.

The base of the abdomen appears always to be margined with a row of large punctures, but these are sometimes almost or quite concealed by the clothing.

The front coxæ vary through all gradations from touching to widely separated—a most unusual feature in any genus of weevils. Between them the prosternum is always divided; at the rear of the division (when the coxæ are distinctly separated) the derm is truncate, but in front there is a more or less conical or rounded process touching the truncated part. There is a certain amount of variation in the degree at which the claws diverge; in some the divergence being slight, in others moderate, but they are never either widely divergent or soldered together at the base.

The derm is often entirely concealed by the clothing, so that to see the colour and sculpture it is necessary to partially abrade one or more specimens. The species are also so frequently covered with mud that even the clothing is concealed, and sometimes stained. I have had specimens for hours in water, and been afterwards unable to remove the mud only, as if too rough a brush is used the clothing comes off as well as the mud. The punctures always appear to be much smaller than they really are, and the carina of the rostrum and the median impression of the prothorax are often partly or entirely concealed.

I do not think that any species of this genus should be described unless one or more specimens has been partially abraded. With unique or rare specimens it is not desirable to entirely abrade the surface, but in such cases I have abraded part of the disc of the prothorax and part of the elytra near the suture and base. It is unsafe as a rule to describe species of which only the females are known, but I have described *niger*, as, even if the type specimens are females, they are unusually distinct.

The clothing is often variegated, and the pattern of the variegation is usually, if not always, variable. The colour is

often not trustworthy, as many of the species appear to have forms in which the derm (especially of the elytra) may be either black or brown, or even of a livid red.

The sexes are usually well defined, and the genus may be readily divided into three groups depending on male characters: —

1. Male with intercoxal process of mesosternum produced into a laminated or conical process.
2. Male with basal segment of abdomen carinate or tuberculate.
3. Mesosternum and abdomen simple in both sexes.

The elytral punctures are usually much larger in the male than in the female, although before abrasion there is not much apparent difference between them. The male is also usually smaller and narrower; with more strongly curved tibiæ. In many of the species the tibiæ (especially the front pair) are ciliated, but (with the exception of *inusitatus)* only in the male, and in the following descriptions it has not been considered necessary to comment on its absence in the females. The hind tibiæ are sometimes dentate or carinate in the male, but never in the female. Where the front coxæ are distinctly separated, the space between them is usually slightly less in the male than in the female, owing to the slightly greater enlargement of his coxæ.

Many species which at first sight strongly resemble each other are seen to be very distinct when the sexual characters or the space separating the front coxæ are examined. The prothoracic sculpture on abrasion is often very useful in distinguishing apparently closely-allied species.

Few of the species appear to be at all widely distributed; and many of them are to be taken at the roots of beach-growing plants; others occur under logs and stones, and a few under bark.

The following table of species known to me is arranged principally for convenience of identification. With the probable exception of *niger*, it is drawn up exclusively from males: to attempt a table that would include females would, I believe, tend only to confuse instead of assist; for this reason *punctiventris* (of which I have only a female) is not included: —

A. Mesosternum with a laminated intercoxal process.
  a. The process extending to middle of front coxæ ... ... *intercoxalis*, n. sp.
  aa. The process much shorter
    b. Base of process flat ... ... *hoplostethus*, Pasc.
    bb. Base of process convex ... ... *simulator*, n. sp.

AA. Mesosternum with a more or less conical intercoxal process.
c. Apical half of elytra irregular ... ... *crudus*, Er.
cc. Apical half of elytra regular.
d. Setæ of upper surface rather dense, long, and thin ... ... *variabilis*, n. sp.
dd. Setæ of upper surface much sparser, shorter, and stouter ... ... *vacillans*, n. sp.
AAA. Mesosternum without a laminated or conical intercoxal process.
B. Middle of basal segment of abdomen impinging on second ... ... *ventralis*, Blackb.
BB. Middle not so impinging.
C. Abdomen carinate or tuberculate.
e. Basal segment of abdomen bituberculate ... ... *geminatus*, n. sp.
ee. Basal segment with a median tubercle ... ... *tuberculiventris*, n. sp.
eee. Basal segment with a longitudinal carina on each side of middle ... *excavatus*, Lea.
eeee. Basal segment with a transverse or curved apical or subapical carina.
f. Front coxæ touching ... ... *bryophagus*, n. sp.
ff. Front coxæ feebly separated.
g. Basal segment of abdomen incurved to middle of apex ... *Blackburni*, n. sp.
gg. Basal segment straight at apex *litoralis*, n. sp.
fff. Front coxæ distinctly and usually widely separated.
h. Elytra tuberculate.
i. Apex of hind tibiæ suddenly and strongly incurved ... *longicollis*, n. sp.
ii. Apex almost straight ... *arciferus*, n. sp.
hh. Elytra non-tuberculate.
j. Suture with small shining granules.
k. All segments of abdomen with shining granules ... *granulatus*, n. sp.
kk. Third and fourth segments without such granules ... ... *carinativentris*. n. sp.
jj. Suture without such granules.
l. Abdominal carina feebly arched ... ... *imitator*, n. sp.
ll. Abdominal carina strongly arched.
m. Alternate interstices raised ... ... *Carteri*, n. sp.
mm. Alternate interstices not raised.
n. Scutellum small and shining ... ... *sabulosus*, n. sp.
nn. Scutellum not traceable ... ... *Sydneyensis*, n. sp.
CC. Abdomen not carinate or tuberculate.
D. Upper surface glabrous ... ... *glaber*, Blackb.

DD. Upper surface distinctly and usually densely clothed.
E. Elytra tuberculate.
o. Hind tibiæ dentate at base ... *scaber*, Lea.
oo. Hind tibiæ not dentate at base.
p. Under surface with long pubescence ... ... *mirabilis*, n. sp.
pp. Under surface without such pubescence.
q. Space between middle coxæ not much more than that between front pair.
r. Front tibiæ not ciliated *niger*, n. sp.
rr. Front tibiæ densely ciliated ... ... *Coatesi*, n. sp.
qq. Space between middle coxæ much greater than between front pair ... ... *campylocnemis*, Lea
EE. Elytra non-tuberculate (at least elsewhere than about shoulders).
F. Prothoracic granules transversely arranged or subcarinate.
s. Abdomen sparsely clothed ... *Crawfordi*, Blackb.
ss. Abdomen densely clothed.
t. Size very small.
u. Base of elytra gently and regularly emarginate ... *arcuatus*, n. sp.
uu. Base of elytra trisinuate *trisinuatus*, n. sp.
tt. Size above average ... ... *setosus*, n. sp.
FF. Prothoracic granules not so arranged.
G. Scape very stout.
v. Prothorax with large isolated granules or small tubercles ... ... *nodicollis*, n. sp.
vv. Prothoracic granules not large and isolated ... *crassicornis*, n. sp.
GG. Scape at most moderately stout.
H. Hind tibiæ bidentate ... *Fergusoni*, n. sp.
HH. Hind tibiæ not bidentate.
I. Prothoracic granules not obscured by clothing.
w. Basal segment of abdomen with granules ... *seticollis*, n. sp.
ww. Basal segment without granules ... ... *reticulatus*, Lea.
II. Prothoracic granules partially obscured or absent.
J. Front coxæ more or less widely separated.
x. Emargination of apex of prosternum sudden and deep ... *amplicollis*, Lea.
xx. Emargination not sudden and deep.
y. Suture between basal segments of abdomen almost obsolete in middle *sterilis*, Er.?

yy. Suture distinct across middle.
z. Prothorax (on abrasion) with very minute granules on disc.
a. Front tibiæ with long and moderately dense ciliation ... *similis*, n. sp.
aa. Front tibiæ with rather short and feeble ciliation ... ... *ochreonotatus*, n. sp.
zz. Prothorax (on abrasion), with large but almost obsolete granules ... *Blackmorei*, n. sp.
zzz. Prothorax (on abrasion), with distinct granules on disc.
b. Front tibiæ densely ciliated at apex... *piliventris*, Lea.
bb. Front tibiæ feebly ciliated at apex.
c. Base of elytra trisinuate . *humeralis*, n. sp.
cc. Base regularly emarginate.
d. Front tibiæ dentate ... *avenaceus*, n. sp.
dd. Front tibiæ edentate ... *albonotatus*, n. sp.
JJ. Front coxæ not widely separated.
K. Derm nowhere black *pallidus*, Lea.
KK. Derm black, at any rate in parts.
L. Suture (on abrasion) decidedly paler than second interstice ... *suturalis*, Lea.
LL. Suture black or almost so.
M. Front coxæ touching.
e. Club reddish ... *maculatus*, n. sp.
ee. Club black or almost black *inusitatus*, n. sp.

MM. Front coxæ not touching.	
N. Length of eyes greater than space between them ...	*pusillus*, Lea.
NN. Length less than space between them.	
O. Prothoracic sculpture not entirely concealed before abrasion ...	*subglaber*, Lea.
OO. Prothoracic sculpture entirely concealed before abrasion.	
P. Hind tibiæ suddenly narrowed about the middle .	*cellaris*, Pasc.?
PP. Hind tibiæ not suddenly narrowed there ...	*spurcus*, Lea.

Notes on above Table.

eeee. This carina usually, but not always, marks the hinder margin of a flattened space.

ü. Except for the usual inflation of apex.

r. There are the usual setæ on the tibiæ, however.

F. The prothorax has the granules so arranged that there appear to be fine striæ separating them into sub-parallel lines; the arrangement as a rule being fairly easily seen through the clothing, and always distinct on abrasion.

G. In *amplicollis* and several other species the scape is stouter than usual, but in these two it is quite remarkably stout.

v. These can only be seen after abrasion, however.

II. In many of the species the granules are readily traceable, but the clothing usually prevents the granules themselves from being seen.

Excluding *pilosus*, Blackb., and *pinguis*, Lea, which do not belong to the genus, and are referred to below, the following is a list of the species hitherto described: —

crudus, Er.
rigidus, Er.
sterilis, Er.
vetulus, Er.
Dysostines fuligineus, Pasc.
valgus, Pasc. (*Dysostines*).
pilipes, Pasc. („).
hoplostethus, Pasc. („).
pustulosus, Pasc. („).
cellaris, Pasc. („).
Crawfordi, Blackb. („).
ventralis, Blackb. („).
punctiventris, Blackb. („).
glaber, Blackb. („).
advena, Blackb. („).
campylocnemis, Lea.
piliventris, Lea.
scaber, Lea.
amplicollis, Lea.
spurcus, Lea.
excavatus, Lea.
suturalis, Lea.
pallidus, Lea.
reticulatus, Lea.
pusillus, Lea.
subglaber, Lea.

Mandalotus sterilis, Er.

Twelve specimens of a narrow species from Ulverstone (near the original locality in Tasmania) probably belong to this species; they are somewhat variable in markings, as are most species of the genus.

Mr. Blackburn says of the type, "the suture between the first and second ventral segments is extremely fine": this is the case with my specimens *across* the middle (in fact in some specimens the suture in the very middle seems quite obliterated), but at the sides it is well defined, although not so deep or wide as those of the following segments. This character will readily distinguish it from most species, but in this, and many other characters, it strongly resembles the female of *ventralis*.

The prothoracic granules are traceable to a certain extent through the clothing, and on abrasion are seen to be large, round, and feeble; the elytral punctures in the striæ are (for

the genus) decidedly small, being much narrower than the interstices. The degree in which the alternate interstices are raised above their fellows is somewhat variable. The prothorax has a median line, but it is quite concealed normally. The size varies from $4\frac{3}{4}$ to 6 mm.

The sexes are very ill-defined: in some males, however, the front tibiæ are more strongly curved on the apical third, and the basal portion is supplied below with a narrow keel, which sometimes is rather suddenly terminated, but both curvature and keel are not of constant strength, and those of some males are not to be distinguished from some females. In the male also the basal segment of the abdomen has an arcuate apical median space slightly depressed below the basal portion (but not concave).

Mandalotus crudus, Er.

In specimens in good condition the median prothoracic impression is scarcely, or not at all, traceable.

Mandalotus ventralis, Blackb.

Remarkably distinct by the abdomen of the male. I have specimens from King Island and Tasmania, as well as from South Australia (the original locality). The specimens before me vary from dark brown, with pale markings, to almost white, with more or less distinct brown spots.

Mandalotus valgus, Pasc.

In describing *campylocnemis* and *scaber*, I compared them with a species I supposed to be *valgus;* this species, although it closely agrees with the figure of that species, and in many respects with the description, I now find was wrongly identified, and I have described it as *intercoxalis*.

Mandalotus cellaris, Pasc.

Mr. Masters (from whom the types of this species were received) has given me three Sydney females as belonging to this species: they differ, however, from the description in being smaller (only two lines including the rostrum in its normal position), and have not the hind tibiæ "*intus fortiter bisinuatus*" (probably, however, a masculine character). I have also two specimens (sexes) from the Nepean River, belonging to the same species, and of which the male has the hind tibiæ (as seen from the sides) regularly dilated to about the middle, and thence strongly arcuate to the apex: seen directly from above or below also, the apical third appears much narrower than the basal two-thirds. From *spurcus* it differs in having the front coxæ more distant, and the median line less distinct, as well as in the hind tibiæ.

MANDALOTUS SCABER, Lea.

The base of the hind tibiæ of the male of this species has an acute transverse carina, somewhat as in the male of *crudus*, but more acute and much nearer the base.

MANDALOTUS PILOSUS, Blackb.

I have a specimen of this species (named by Mr. Blackburn himself, and agreeing with his description) which was somewhat doubtfully referred to *Dysostines*. The ocular lobes are entirely absent, and the front coxæ are contiguous. I refer it, without doubt, to *Timareta*.

MANDALOTUS PINGUIS, Lea.

Also now referred to *Timareta*, as in its absence of ocular lobes and contiguous front coxæ it agrees with the preceding, and with *crinita*.

MANDALOTUS INTERCOXALIS, n. sp.

Male. Blackish, antennæ and parts of legs dull red. Densely clothed with muddy-brown, feebly-variegated scales, the paler ones forming feeble rings on legs. With stout, suberect or decumbent setæ, rather sparse elsewhere than on legs; basal segments of abdomen with finer setæ than elsewhere; front tibiæ with rather fine setæ, but not ciliated.

Rostrum with carina concealed, except at base and apex. Second joint of funicle slightly longer than first. *Prothorax* with a median line and a transverse waved impression, both partially concealed; with minute, scattered, quite-concealed granules. *Elytra* trisinuate at base; with obtuse tubercles, more distinct at summit of posterior declivity than elsewhere; with rows of large round punctures. *Mesosternum* with a laminated process extending to middle of front coxæ. Basal segment of *abdomen* concave. *Legs* stout; front coxæ widely separated; tibiæ curved at apex, especially the front pair. Length $6\frac{1}{4}$ mm.(2)

Hab.—New South Wales: Cooma.

The elytral punctures appear to be considerably narrower than the interstices, but after abrasion they are seen to be almost or fully as wide. The intercoxal process of the mesosternum is twice as long as its greatest width (which is about one-third from the base), is flat, but at the apex slightly turned up, it is narrowed towards the base and towards the apex, but not at the apex itself, and is densely squamose, except at its base; the process of *hoplostethus* is much shorter (not once and one-half as long as wide), strongly curved, and almost glabrous.

(2) The lengths given are exclusive of the rostrum.

MANDALOTUS SIMULATOR, n. sp.

Male. Black, in places dull red; antennæ and parts of legs reddish. Densely clothed with pale muddy-brown scales, feebly variegated in places with paler and darker scales; legs feebly alternately banded with pale and dark scales. With stout, suberect setæ, varying from pure white to almost black; tibiæ with sparse ciliation in addition to setæ.

Rostrum without visible carina. Two basal joints of funicle equal in length. *Prothorax* feebly transverse, sides strongly rounded, with a distinct median line; with obtuse, quite-concealed granules. *Scutellum* small but distinct. *Elytra* conjointly arcuate at base (but apparently trisinuate from some directions, owing to thickening of the third interstices at base), subtuberculate in places; with rows of large round punctures. *Mesosternum* with a laminated process about as long as wide. *Abdomen* with basal segments flat in middle. *Legs* stout; front coxæ widely separated; front tibiæ strongly curved at apex. Length 4-5¼ mm.

Hab.—New South Wales: Nepean River (A. J. Coates).

So far as it is possible to judge before abrasion, one of the specimens is entirely of a rather pale red or livid yellow, two others appear to have the body entirely dark, except for the tubercular elevations, which are of a rather dull red; the femora of one of these latter are almost black, but in the other they are not much darker than the tibiæ. The elytra appear to have numerous feeble whitish spots in two of the three specimens before me; their setæ are not regularly distributed, and are almost confined to the alternate interstices; the abdomen is not so densely clothed as the upper surface. The elytral punctures appear to be rather small, but on abrasion many are seen to be even wider than the interstices. The intercoxal process of the mesosternum is distinctly shorter than in *hoplostethus*, and convex (instead of flattened) at its base, but then curved round as in that species.

MANDALOTUS VARIABILIS, n. sp.

Male. Black or dark brown; legs (wholly or in part) and antennæ of a dull red. Densely clothed with muddy or slaty-brown scales, variegated with patches or spots of paler scales. Densely clothed with rather long and fine setæ, depressed on prothorax, suberect on elytra; under-surface and legs with rather dense fine setæ, but with scales very sparse and confined to small spots.

Rostrum with narrow and well-defined carina. Antennæ rather stout. *Prothorax* with strongly-rounded sides, with numerous shining unipunctuate granules. *Scutellum* small but distinct. *Elytra* conjointly arcuate at base, with series of

large, almost regular punctures, interstices gently and regularly convex. *Mesosternum* with a briefly conical intercoxal process. *Abdomen* rather densely granulate, two basal segments conjointly concave. *Legs* rather stout: front coxæ moderately separated; tibiæ inflated at apex, and all more or less feebly granulate below. Length 5-5½ (female 5½-7) mm.

Female. Differs in being larger and wider, mesosternum simple, basal segment of abdomen impressed on the apical half of its middle only, the second not at all concave, tibiæ less curved, and the elytral punctures much smaller (before abrasion, however, they appear to be of the same size).

Hab.—Tasmania: Hobart, Nubeena (at roots of beach-growing plants).

The clothing is very variable: on numerous specimens (especially males) it is of a slaty-brown colour, with small but fairly-distinct paler spots; the spots may be confined to the sides and apex, or extend across the disc (both of prothorax and elytra) as well: in some specimens scales are more of a yellowish-brown colour, with (or without) feeble paler spots; the clothing of the head is usually, but not always, paler than on the rostrum. The scales on the prothorax are sparser than on the elytra, but the setæ are considerably denser, although less distinct; the elytral setæ are not confined to alternate interstices. The granules on the prothorax, although usually placed amongst rather dense scales, are quite distinct before abrasion, and each has a central puncture: the median line is usually distinct, but is never deep or wide, occasionally it is partially concealed by the setæ and scales. In the male the punctures in the striæ are not much narrower than the interstices, but in the female they are considerably narrower: in both sexes, however, their size is obscured by the clothing. The mesosternal process is much as in *crudus*, but the abdomen is more decidedly concave, the elytra are entirely without tubercles, and the hind tibiæ are edentate: the clothing also is different.

MANDALOTUS VACILLANS, n. sp.

Male. Black: antennæ (scape darker than funicle), tarsi, apex of tibiæ and base of femora of a dull red. Densely clothed with scales varying from almost white to almost black. With moderately stout and not very dense setæ, also variable in colour.

Rostrum with carina distinctly traceable through, but concealed by, clothing; scrobes less curved than usual. Scape strongly dilated towards apex. *Prothorax* with numerous round flattened granules, traceable through, but concealed by, clothing; median line feeble or absent. *Elytra* conjointly arcuate at base; with series of large, round, regular, more or

less concealed punctures; fifth interstice with a feeble subtubercular swelling posteriorly. *Mesosternum* with a very obtusely conical intercoxal process. *Abdomen* with basal segments feebly convex in middle. *Legs stout;* front coxæ moderately separated; front tibiæ not strongly curved, the others almost straight. Length 4¼ mm.

Hab.—Tasmania: Hobart (A. M. Lea).

I believe the female of this species is before me, but as I am not quite certain of it, it is not further commented upon.

The three apical segments of the abdomen and the coxæ are sometimes of a dull red. On one specimen the scales are almost black, with feeble pale rings on the legs and a few pale spots on the elytra and sides of prothorax. In another the scales on the upper surface are mostly of a dingy white, mottled with pale and dark brown; in another the scales are slaty brown, with numerous pale spots; in others they are muddy brown, with hardly any variegation. Usually there is a feeble stripe on each side of the prothorax. The setæ, although not confined to alternate interstices, are not regularly distributed. Seen from above, the rostrum appears to have three parallel, partially-concealed carinæ. Before abrasion the prothorax appears to be closely covered with fairly large, round, flattened granules: but these on abrasion are seen to be considerably smaller, although not very small. The interstices are scarcely separately convex, and are about the width of the punctures, although, before abrasion, they appear to be much wider. The intercoxal process of the mesosternum is almost rounded and nowhere suddenly lessened in width, and the abdomen is gently convex; one specimen before me, possibly, however, representing a variety or an undescribed species, has the abdomen gently concave along the middle of the two basal segments, these features readily distinguishing it from *crudus* and the preceding species; but in general appearance it has little in common with those species.

Mandalotus geminatus, n. sp.

Male. Blackish; antennæ (scape darker than funicle), legs (parts of femora excepted or not) and apical half of abdomen of a dull red. Densely clothed with soft muddy-brown scales, feebly variegated with paler scales on the shoulders, sides of prothorax, and on head and rostrum; under surface with rather pale scales. With stout subdepressed setæ.

Rostrum without visible carina. Two basal joints of funicle stout and subtriangular. *Prothorax* feebly transverse, sides subangularly dilated near apex; median line very narrow and quite concealed; with rather sparse, minute, feeble granules, not traceable through clothing. *Elytra* elongate-

cordate, conjointly arcuate at base, shoulders strongly rounded; with series of large, almost concealed punctures; interstices regular. *Abdomen* with a large granule or small tubercle on each side, near apex of middle of basal segment. *Legs* stout; front coxæ touching; tibiæ not strongly curved. Length, 4 mm.

Female. Differs in being wider, abdomen simple, tibiæ straighter, and elytral punctures smaller.

Hab.—Queensland: Cairns (E. Allen).

The majority of the setæ should perhaps be regarded as scales, as they are much wider than is usually the case with setæ, each also is pale at its tip; on the disc of both prothorax and elytra they are wider than elsewhere, and on the elytra they are arranged in quite regular rows. Before abrasion the elytral punctures appear to be rather small, and many are quite concealed, but after abrasion those of the male are seen to be wider than the interstices, whilst those of the female are usually not as wide as the interstices.

MANDALOTUS TUBERCULIVENTRIS, n. sp.

Male. Black; antennæ and parts of legs of a dull red. Densely clothed with muddy brown scales, variegated in places (especially on the prothorax) with paler scales. With moderately dense, stout setæ; on the elytra sparser than elsewhere, not regularly distributed, and almost confined to alternate interstices. Tibiæ with rather sparse ciliation.

Rostrum with narrow and usually concealed carina. Scape but slightly dilated towards apex. *Prothorax* with sides strongly rounded; a narrow but deep median line; apparently without granules. *Elytra* conjointly arcuate at base, with rows of large partially-concealed punctures; interstices with tubercular swellings in places, especially about summit of posterior declivity. Basal segment of *abdomen* with a very distinct median tubercle. *Legs* stout; front and middle coxæ widely separated, the separation of about equal width; tibiæ rather strongly curved. Length, 5 mm.

Female. Differs in having the prothorax narrower and elytra wider, abdomen simple, tibiæ less curved, etc.

Hab.—New South Wales: Sydney (A. M. Lea).

The legs are feebly annulated; on the elytra there are usually small dingy whitish spots of scales and setæ; the paler scales of the prothorax are yellowish-brown. On abrasion the prothorax is seen to have no granules on the disc, but rather large and very feeble ones at sides, these being quite concealed normally. Viewed directly from above or below the hind tibiæ appear to be suddenly narrowed from about their middle.

MANDALOTUS BRYOPHAGUS, n. sp.

Male. Blackish; antennæ and legs (wholly or in part) of a rather bright red. Densely clothed with pale muddy brown scales, feebly mottled with paler and darker scales. Setæ pale and moderately numerous.

Rostrum without visible carina. Second joint of funicle very slightly longer than first. *Prothorax* transverse, sides strongly rounded; with numerous rather large, round, flattened granules, concealed by but traceable through clothing; median line absent. *Elytra* trisinuate at base; with rows of large but more or less concealed punctures. *Abdomen* with all the sutures straight, basal segment with a narrow, feebly-curved carina extending across about one-third of, and almost at, the apex. *Legs* stout, front coxæ touching; tibiæ less strongly curved than usual. Length, $3\frac{1}{2}$-$3\frac{3}{4}$ (female, 4-$4\frac{1}{4}$) mm.

Female. Differs in being larger and wider, abdomen more convex and simple, tibiæ straighter, etc.

Hab.—Tasmania: Frankford, Hobart (A. M. Lea).

The scape is usually darker than the funicle, the middle of the femora and of the tibiæ are usually darker than the other parts of those limbs; the apical segments of the abdomen are sometimes reddish. The mottling of the upper surface is usually very slight, but in some specimens the paler or darker scales appear as small distinct spots. On the elytra the setæ, although not confined to the first, third, and fifth interstices, are more conspicuous on those than on the others. On abrasion, the elytral punctures of the male are seen to be very large and round, in places being twice the width of the interstices; in the female they are usually about the width of the interstices. These before abrasion appear to be much wider (in both sexes) than the punctures; in some specimens also they appear to be feebly alternately raised. The trisinuation of the elytra is caused by the third interstice being subtuberculate at base. The suture between the first and second abdominal segments is perfectly straight; a most unusual feature, although not unique in the genus. The carina of the basal segment, although sufficiently distinct, is apt to be partially concealed by the clothing. The seven specimens before me were all taken in moss.

MANDALOTUS BLACKBURNI, n. sp.

Male. Black; funicle, club, and tarsi reddish. Densely clothed with dark slaty-brown or sooty-brown scales, somewhat paler on undersurface; legs feebly or not at all annulated. With rather dense stout setæ.

Rostrum with a narrow carina, concealed by but distinctly traceable through clothing. Scape moderately but

regularly dilated to apex. *Prothorax* feebly transverse, sides strongly and regularly rounded; with numerous rather large, round, flattened granules, densely clothed but readily traceable; median line feeble and sometimes absent. *Elytra* with the regular emargination of base slightly interrupted by the third interstices; with rows of large, round, partially-concealed punctures, alternate interstices very feebly raised, suture and usually the third with minute shining (but sometimes quite concealed) granules. *Abdomen* with small more or less concealed granules; basal segment at apex incurved to middle, with a distinct shining slightly-curved carina near apex, and about one-third the width of apex. *Legs* very stout; front coxæ feebly separated; tibiæ rather feebly curved, the front pair feebly denticulate below. Length, 4½-5 (female, 4¼-5½) mm.

Female. Differs in having the prothorax narrower and elytra wider, punctures smaller, abdomen more convex and simple and tibiæ straighter.

Hab.—Tasmania: Hobart, Launceston, Stonor, Jordan River (A. M. Lea).

The clothing is occasionally feebly mottled, and in some specimens the alternate interstices are slightly paler than the others. On the upper surface the setæ are usually dark, but on the elytra many of them are whitish, the rows also are not all the same distance apart. The prothoracic granules on abrasion are seen to be each supplied with a distinct puncture (for the reception of a seta), and with other very small ones (for the scales). In the male the elytral punctures are of about equal width with the interstices, but in the female they are smaller; the granules are often confined to the suture and third interstice, but they are occasionally also present on the second. The claws are closer together than usual.

Readily distinguished from the preceding species by the curved apex of the basal segment of abdomen. The two species, however, are not much alike. I sent specimens of this species to the Rev. T. Blackburn, and of them he wrote:—"They are quite distinct from all my species and from Erichson's. The narrower and more brightly coloured specimens (male, I suppose) bear a certain resemblance to *sterilis*, Er., but that species has alternate interstices carinate, suture quite strongly carinate behind, rostral carina much feebler and shorter, no carina on ventral segments (unless I am mistaken in considering it a male)," etc., etc.

Mandalotus litoralis, n. sp.

Male. Black; antennæ and legs (wholly or in part) reddish. Densely clothed with brown, mottled with sooty scales.

With moderately dense, suberect setæ, usually dark, but whitish in places.

Rostrum, scape, and *prothorax* much as in the preceding species. *Elytra* regularly arcuate at base; with series of large round punctures, as wide as interstices or wider, but appearing much smaller through clothing; interstices regular. *Abdomen* with small more or less concealed granules, all the sutures straight; basal segment at apex with a depressed shining almost straight carina, extending across less than one-third of apex. *Legs* stout; front coxæ feebly separated; tibiæ rather feebly curved and all more or less feebly denticulate below. Length, $3\frac{1}{4}$-$3\frac{3}{4}$ mm.

Female. Differs in having narrower prothorax and wider elytra, simple abdomen and straighter tibiæ.

Hab.—Tasmania: Hobart (on sea-beach. A. M. Lea).

On the elytra the bulk of the scales are of a rather pale brown, with the sooty scales in irregular blotches; on the prothorax the sooty scales cover a larger area than the paler ones. In one of the two males before me both hind tibiæ have a minute inner tooth about one-third from apex. The claws are as close together as in the preceding species, from which it is readily distinguished by the straight abdominal suture, in consequence of which the basal segment is fully twice the length of the second along the middle, instead of about once and a half as in that species. From *bryophagus* it is distinguished by the slightly separated front coxæ and regularly arcuate base of elytra, etc.

Mandalotus arciferus, n. sp.

Male. Black; antennæ, tibiæ, and tarsi reddish. Densely clothed with muddy-brown scales; with rather long suberect setæ. Tibiæ with a rather thin fringe of long cilia.

Rostrum with carina rather feebly traceable through clothing. Antennæ thin; scape rather suddenly thickened at apex; first joint of funicle fully once and one-half the length of second. *Prothorax* feebly transverse, sides strongly but not uniformly rounded; median line narrow and usually concealed; closely covered with large, flattened, and more or less rounded granules, not very distinctly traceable through clothing. *Elytra* trisinuate at base, base not quite as wide as near apex of prothorax; with subtubercular elevations in places; with series of large, round, more or less irregular, and usually concealed punctures. *Abdomen* with a semi-circular, flat, shining basal space on basal segment, marked outwardly by a distinct carina, apex strongly incurved to middle. *Legs* stout; front coxæ widely, the middle still more widely separated; tibiæ rather thin, the front pair strongly bisinuate be-

low, the others rather feebly bisinuate. Length, 4½-5½ mm.

Female. Differs in having the prothorax narrower and elytra wider, abdomen simple, appendages shorter, tibiæ stouter, the front pair much less strongly bisinuate and the others almost straight.

Hab.—Tasmania (Macleay Museum): King Island (Jas. A. Kershaw and A. M. Lea); Victoria: Mordialloc (National Museum).

The scales on most of the specimens before me (except for feeble rings on the legs) are quite uniformly coloured, but on some there are very feeble traces of pale spots. The setæ are rather denser and longer than usual, although not so dense or thin as in *variabilis;* they are mostly dark-brown in colour, but many are straw-coloured; on the lower surface they are thinner than on the upper. The prothoracic granules are rather large and less uniform than in the two preceding species, but are much less distinct through the clothing. Many of the elytral punctures are also scarcely traceable, but on abrasion they are seen to be much wider than the interstices, and not in quite regular rows; the interstices themselves are decidedly irregular, and on abrasion are seen to be highly polished and without punctures. The subtubercular elevations vary on different specimens.

The male has an abdominal plate somewhat as in *ventralis;* but the flattened space is transverse and does not infringe on the second segment; in *ventralis* the first segment along its middle is about thrice the length of the second; but in the present species the first is but slightly longer than the second. The carina also appears almost to connect the hind coxæ together; at its apex it does not touch the apex of the segment; and the tibiæ are very different.

Mandalotus longicollis, n. sp.

Male. Black; antennæ, tibiæ (partly or entirely), and tarsi reddish. Densely clothed with dark muddy-brown scales, with rather stout, semi-decumbent setæ. Tibiæ fringed with long cilia.

Rostrum with a narrow carina, more or less concealed, except towards apex. Antennæ rather thin. *Prothorax* (by measurement) slightly longer than wide, sides regularly rounded; median line narrow and partly concealed; with numerous fairly large, rounded (scarcely flattened) granules, not very distinct before abrasion. *Elytra* strongly trisinuate at base, interstices subtuberculate in places, with rows of large more or less concealed punctures. *Abdomen* with a flattened space curved towards and extending almost to apex, and bounded behind by a feeble carina, apex feebly incurv-

ed to middle. *Legs* stout; front coxæ very widely separated; front tibiæ strongly bisinuate, hind pair strongly incurved at apex. Length, 6½ mm.

Hab.—New South Wales: Jindabyne (H. J. Carter).

On the sides and shoulders of prothorax the scales are rather paler than elsewhere, but in the only specimen before me they are nowhere distinctly variegated. On the elytra the setæ are rather sparsely and irregularly distributed, elsewhere they are fairly dense. The prothoracic granules are not clearly defined through the clothing. The third interstice at its base is thickened to a much greater extent than usual, is thickened again at its middle, and then depressed below the others; the punctures are somewhat irregular and are usually wider than the interstices; although before abrasion apparently much smaller or quite absent. The interstices on abrasion are seen to be shining, almost or quite impunctate and with minute scattered granules (these quite invisible normally). The middle of the prosternum is slightly concave in front of and slightly concave behind the median sulcus, and is marked with large punctures, and which are not at all concealed by scales. The apex of the abdominal plate is terminated by a feeble, almost double carina (this appearance being due to an impression along its middle), at its middle it quite touches the apex.

In general appearance rather close to the preceding species, but the prothorax longer than wide, with larger and less flattened granules, elytra more decidedly trisinuate at base, and abdominal carina different. The antennæ are much the same, but are not quite so long, the scape is not so suddenly thickened at apex, and the basal joint of funicle is shorter. The hind tibiæ have the same remarkable apex as in the male of *ventralis*, but are longer and thinner and are without granules; the basal segment of abdomen is also incurved instead of outcurved at the middle of its apex.

Mandalotus granulatus, n. sp.

Black; antennæ and appendages (these in parts stained with black) reddish. Densely clothed with muddy-brown feebly-variegated scales; legs feebly ringed. With rather numerous straw-coloured setæ. Tibiæ with thin setæ, but not fringed with long cilia.

Rostrum with a narrow carina, concealed on basal half. Antennæ rather stouter than in the preceding species, with the scape more sinuous. *Prothorax* (by measurement) just perceptibly longer than wide, with a feeble concealed median line, granules much as in preceding species. *Elytra* trisinuate at base; alternate interstices slightly raised, first and

third with numerous (the others with few or none) small shining setose granules; punctures not very distinct through clothing, and on abrasion narrower than interstices. *Under-surface* with small shining granules, more numerous and rather larger on abdomen than elsewhere. Basal segment of *abdomen* feebly incurved at apex, with a strong carina extending about half way across near (its middle on) the apex, moderately curved at sides, its middle very feebly incurved. *Legs* moderately stout; front coxæ widely separated; femora with a few minute granules; tibiæ granulate below, front pair strongly curved, the others almost straight. Length, 7 mm.

Hab.—Tasmania: Mount Wellington (A. M. Lea).

Each granule of both upper and lower surfaces bears a seta, although all the setæ do not rise from granules.

In general appearance close to the preceding species, but the prothorax slightly shorter; the elytra with granules larger, more numerous, and quite distinct before abrasion, not so strongly trisinuate at base, the shoulders more advanced, subtuberculate only at base, the punctures smaller, the hind tibiæ and the abdominal granules and carina different.

Two females, from Hobart and Launceston, probably belong to this species; they differ from the male in having the prothorax feebly transverse, the elytra with numerous pallid spots, the abdomen more convex and non-carinate, the tibiæ straighter, and the granules on the legs not quite so conspicuous.

MANDALOTUS CARINATIVENTRIS, n. sp.

Male. Black; antennæ and legs dull red. Densely clothed with muddy-brown, mottled with paler and darker, scales; legs feebly ringed; with rather long and stout setæ, less numerous and regular but more conspicuous on elytra than on prothorax.

Rostrum with carina concealed by clothing, but distinctly traceable throughout. *Prothorax* apparently as long as wide, sides strongly and evenly rounded; median line partially concealed; with dense, round, flat, fairly large granules, distinctly traceable through clothing. *Elytra* with basal arcuation feebly sinuous; with regular rows of large, partially-concealed punctures; interstices very feebly alternately raised, the first to third with minute shining granules. *Abdomen* with numerous small granules on first and fifth segments, and a few very indistinct ones on second; first feebly incurved at apex, with a strong, shining, feebly-curved carina, the middle of its apex on apex of segment. *Legs* strong; front coxæ widely separated; tibiæ granulate below, the front pair strongly curved towards apex, apex itself (as also that

of the second pair) acutely produced; claws very feebly separated. Length, 6 mm.

Female. Differs in being more robust, abdomen more convex and without carina, tibiæ straighter, etc.

Hab.—Tasmania: Frankford (in moss), Swansea (A. M. Lea).

The scape is darker than the funicle, and the legs are not of uniform colour. On one specimen the apical scales of the femora are almost golden, on several some of the scales on head and apex of rostrum have a distinct bluish gloss; there is usually a small patch of pale scales on each side near the scutellum. The minute elytral granules are quite distinct in both sexes before abrasion, the interstices from above seem perfectly uniform, but from behind feebly alternately raised; they appear to be much wider than the punctures, but on abrasion are seen to be only about the same width.

Shorter and more robust than the preceding species, granules less conspicuous, and on the third and fourth abdominal segments quite absent; the front tibiæ are also acutely produced at the apex, whilst in the preceding species the produced part (although appearing pointed from some directions) is really in the form of a flange, slightly incurved at its apex. The abdominal carina is almost as in *Blackburni*, but the front coxæ are rather widely separated instead of almost touching as in that species.

Mandalotus imitator, n. sp.

Densely covered with muddy-brown scales, feebly variegated on prothorax and base of elytra; with moderately long subdecumbent setæ.

Rostrum rather stouter than usual, carina traceable throughout, but uncovered only on apical third. Antennæ rather short, but not very stout. *Prothorax* feebly transverse, sides strongly and evenly rounded; granules much as in preceding species; without median line. *Elytra* conjointly arcuate at base: with large, partially-concealed punctures; interstices quite regular. *Abdomen* as in the preceding species, except that the carina does not quite touch the middle of apex. *Legs* stout: front coxæ widely separated; tibiæ dentate below, front pair strongly curved towards and swollen at apex, then somewhat acutely produced. Length, 6½ mm.

Hab.—Tasmania: Swansea (A. M. Lea).

The type and only specimen I have seen is entirely of a dull or livid red (except as to its clothing), but this may be due to immaturity. Probably its colours are like those of most species, *i.e.*, black, with more or less red appendages. On the elytra the setæ are rather long and of two colours—

dark-brown and whitish; on the prothorax they are shorter and almost black. Before abrasion the interstices seem much wider than the punctures; but after, they are seen to be of equal width.

In appearance very close to the preceding species; but the elytra entirely without granules; the apex of the front tibiæ is intermediate in character between that species and *granulatus*, in having only one side of the flange produced.

MANDALOTUS CARTERI, n. sp.

Male. Colour and clothing much as in *longicollis*.

Rostrum with carina concealed. Antennæ thin. *Prothorax* moderately transverse, sides strongly rounded; median line feeble, with very feeble tubercles, scarcely traceable before abrasion. *Elytra* scarcely trisinuate at base; interstices elevated, with rows of large, partially-concealed punctures. *Abdomen* much as in *arciferus*, but the middle of the carina distant fully one-third from the apex of basal segment. *Legs* stout; front coxæ widely separated; front tibiæ strongly bisinuate below, middle pair swollen on basal half, and strongly curved on apical half, hind pair feebly curved, not strongly incurved at apex. Length, 6 mm.

Hab.—New South Wales: Jindabyne (H. J. Carter), Mount Kosciusko (R. Helms).

The clothing of the under surface is rather sparse, and consists mostly of fine setæ, but that of the upper surface and of the legs is almost exactly as in *longicollis;* but the abdominal carina and hind tibiæ are very different to those of that species. In *arciferus*, which at a glance it strongly resembles, the carina is much nearer the apex, and the prothoracic and elytral sculpture are seen to be very different on abrasion.

MANDALOTUS SABULOSUS, n. sp.

Male. Dark reddish-brown, appendages paler. Densely covered with slaty-grey scales, sometimes more or less mottled; with moderately long and thin semi-erect setæ. Tibiæ with a rather thin fringe of cilia.

Eyes smaller and more convex than usual. *Rostrum* with carina uncovered throughout. Antennæ thin, first joint of funicle fully once and one-half the length of second. *Prothorax* moderately transverse, sides strongly and almost uniformly rounded; median line usually distinct; with dense, round, flattened granules, only partially concealed. *Scutellum* small but distinct, and shining. *Elytra* almost truncate at base, elongate subcordate; with rows of comparatively small, partially-concealed punctures; interstices gently and regularly convex. *Abdomen* densely punctured, the two basal

segments wrinkled as well; basal with a narrow curved apical carina. *Legs* strong; front coxæ rather widely separated; tibiæ granulate below, rather strongly inflated at apex, the front pair more noticeably curved than the others. Length, 5½-6 mm.

Female. Differs in being rather more robust, abdomen more convex, less wrinkled, and non-carinate, and the tibiæ straighter.

Hab.—Tasmania: Ulverstone, Swansea (A. M. Lea).

A narrow species readily distinguished from most others by the scarcely emarginate base of elytra and shining scutellum, the latter being distinct in all the numerous specimens before me. The scales on the upper surface are sometimes quite uniform in colour, but they are often variegated with spots of paler scales; towards the apex of the elytra there are often patches of pale and dark scales, quite strongly contrasted. The setæ of the legs are unusually long. The scales of the prothorax are very readily abraded, so that its disc often appears to be almost glabrous. The rostral carina is distinctly traceable throughout; behind it, on the head, there is a distinctly impressed line. The abdominal carina at its middle touches the apex of the segment, but it is not very conspicuous, owing to the way that segment is wrinkled, and it does not extend across one-third of the width. The species is abundant at the roots of beach-growing plants.

Mandalotus Sydneyensis, n. sp.

Male. Dark, reddish-brown; coxæ and apex of abdomen paler, antennæ, tibiæ, and tarsi still paler. Densely clothed with slaty-grey scales, mottled with small spots of brown. Clothed with long, thin, pale, semi-erect setæ. Tibiæ ciliated.

Rostrum with moderately distinct carina. Antennæ thin, first joint of funicle not much longer than second. *Prothorax* much as in the preceding species, except that the granules are not so distinct; *elytra* shorter, but otherwise much the same. *Scutellum* absent, or at least not visible. *Abdomen* as in the preceding species, except that the punctures are stronger, the wrinkles less conspicuous and the carina more so. *Legs* much the same. Length, 5 mm.

Hab.—New South Wales: Sydney (H. W. Cox).

In appearance close to the preceding species, with which it agrees in the subtruncate base of elytra and in the sexual differences, but it is shorter and with the setæ (especially on the elytra) distinctly longer; the scutellum also appears to be quite absent. The rostral carina, although not covered with scales, is partly obscured by setæ.

MANDALOTUS MIRABILIS, n. sp.

Male. Black; antennæ and tarsi reddish. Densely clothed with muddy-brown scales. With moderately dense but rather short setæ, which on the elytra are irregularly distributed. Under surface, except on sides, with long, thin straw-coloured hair. Front tibiæ with dense and long cilia.

Rostrum stout, carina distinct throughout. Antennæ rather thin. *Prothorax* decidedly transverse, sides very strongly rounded, apex subtubular; with numerous oblong or elliptic granules, more or less transversely or obliquely arranged. *Elytra* somewhat sinuous at base, with a rather large tubercular swelling just behind each shoulder on the side, elsewhere (especially about and on posterior declivity) with subtubercular elevations. *Abdomen* concave along middle. *Legs* strong; front coxæ widely separated; tibiæ wider than usual, all more or less strongly curved, the hind pair distorted at apex. Length, 9½ mm.

Hab.—New South Wales: Illawarra (Australian or Macleay Museum).

Larger and probably more distinct than any other known species. From the description of *valgus*, and all other species, the long clothing of the under surface will readily distinguish it; this clothing appears to be of three kinds—long thin hair clothing most of the under surface, towards the sides interspersed with stout setæ, and at the sides scales. The front tibiæ have denser and perhaps longer ciliæ than any other species here noted; the hind tibiæ are rather sparsely and the middle tibiæ scarcely ciliated. The clothing is so dense as almost to prevent the sculpture being traced through it; on abrasion the prothorax is seen to have a distinct median line, and to be covered with numerous granules appearing like interrupted carinæ. The scutellum appears to be of comparatively large size, although normally quite concealed. The elytral punctures are often quite hidden, but are large, round, and wider (except at the thickened parts) than the interstices. Each of the middle coxæ appears to be concave internally, or to be supplied with an arcuate carina, the convex side of which is towards the side. The hind tibiæ are very strongly and suddenly inflated and curved at the apex (in addition to the ordinary curvature), this portion being highly polished internally; at its inner apex it is terminated by three small spines or teeth; the tarsi are set on the inflated portion. The front tibiæ appear to be slightly twisted, with a carina or ridge marking the upper side of each.

MANDALOTUS NIGER, n. sp.

Black; funicle, club, and tarsi reddish. Very densely

clothed with black scales, becoming greyish on parts of the legs and under surface; with short, stout, more or less decumbent setæ.

Rostrum stout; carina covered with scales, but feebly traceable throughout. Antennæ moderately stout. *Prothorax* moderately transverse, sides strongly rounded; median line partly concealed; with numerous large, rounded granules or small tubercles, not very clearly traceable through clothing. *Elytra* conjointly but not quite regularly arcuate at base, subtuberculate in places, and especially about posterior declivity; with large, round, almost concealed punctures. *Abdomen* feebly convex. *Legs* stout; front coxæ widely separated; tibiæ feebly curved, the posterior almost straight. Length, 6-7 mm.

Hab.—New South Wales: Blue Mountains (E. W. Ferguson).

On the prothorax the setæ vary from straw-coloured to black, on the elytra they are nearly all deep black, and are short, stout, and very irregularly distributed. The elytral punctures are as wide as the interstices, but the clothing is so dense that they appear much smaller, and many are quite concealed.

Two specimens are before me, both apparently of one sex, and probably females. I have described them, however, as even as females they represent a very distinct species. In build they have a certain resemblance to *amplicollis*, but apart from the clothing, the emargination of apex of prosternum is much less sudden and deep.

Mandalotus Coatesi, n. sp.

Male. Black; antennæ, legs, and apical half of abdomen reddish. Densely clothed with uniformly pale muddy-brown scales. With stout and rather pale setæ, sparser, and more irregularly distributed on elytra than elsewhere; under surface with thin setæ. Front tibiæ densely ciliated.

Rostrum stout, antennæ rather thin. *Prothorax* feebly transverse, sides regularly rounded; median line partly concealed; with numerous, large, round, flattened granules, readily traceable through clothing. *Elytra* trisinuate at base; subtuberculate in places; with large, round punctures, much wider than interstices, but appearing much narrower through clothing. *Abdomen* granulate, two basal segments feebly concave. *Legs* stout; front coxæ widely separated; tibiæ granulate below, front pair strongly curved at apex, hind pair dilated to middle, then suddenly narrowed towards (but not at) apex. Length, 4¼ mm.

Female. Differs in being more robust, elytral punctures

smaller, abdomen gently convex, tibiæ straighter, the hind pair longer and not so suddenly narrowed beyond the middle.

Hab.—New South Wales: Richmond River (A. J. Coates).

Of the two specimens before me, the female has the rostral carina uncovered throughout, in the male it is uncovered only on the apical half. The hind tibiæ of the male appear to be obtusely dentate at about their middle.

MANDALOTUS ARCUATUS, n. sp.

Male. Blackish; appendages reddish. Densely clothed on both surfaces with pale, muddy-grey scales; with short, stout setæ, longer, sparser, and less depressed on elytra than on prothorax. Front tibiæ with long but sparse cilia.

Rostrum with carina more or less concealed by clothing. Antennæ rather thin. *Prothorax* flattened, moderately transverse, sides strongly and regularly rounded; median line absent; with transverse granules or interrupted carinæ, more or less concealed by clothing. *Elytra* conjointly arcuate at base; with large, round punctures the width of interstices, but appearing much smaller through clothing, interstices regular. *Abdomen* with two basal segments very feebly concave in middle. *Legs* stout, especially front femora; coxæ widely separated, front tibiæ strongly curved at apex. Length, 2½ mm.

Female. Differs in having the prothorax narrower and elytra wider, abdomen gently convex and front tibiæ straighter.

Hab.—New South Wales: Rooty Hill (E. W. Ferguson).

In appearance like a small *Polyphrades*, and the sexes differ in much the same way, but the claws are separated at an angle of about 45 degrees.

MANDALOTUS TRISINUATUS, n. sp.

Male. Reddish-brown, appendages paler.

Rostrum with carina very feebly or not at all traceable through clothing. Antennæ rather thin. *Prothorax* moderately convex and transverse; sides strongly rounded; median line absent; with large transverse granules or interrupted carinæ. *Elytra* trisinuate at base; with large round punctures, the width of, or wider than, interstices, but more or less concealed; alternate interstices raised. *Abdomen* with two basal segments gently concave. *Legs* stout; front coxæ rather widely separated, middle coxæ not quite so widely separated; front tibiæ rather strongly curved at apex, hind pair inflated and distorted at apex, and subdentate at basal third internally. Length 3 mm.

Hab.—Victoria: Bright (C. French).

In general appearance and with clothing as in the preceding species, but readily distinguished therefrom by the trisinuate base of elytra, which also has the alternate interstices raised; the prothorax is more convex and its granules or carinæ are also decidedly wider and less numerous; the hind tibiæ are also very different.

MANDALOTUS SETOSUS, n. sp.

Male. Densely clothed with muddy-brown, very feebly variegated scales. Prothorax with semi-erect, rather short brown setæ, directed towards the middle from each side; elytra with pale and dark setæ, dense on suture, third, fifth, and seventh interstices, very sparse between these, and absent on sides, except at base and apex. Front tibiæ with comparatively short and sparse cilia.

Rostrum with carina uncovered only on apical third. Antennæ thin, but scape rather suddenly thickened at apex. *Prothorax* feebly transverse, sides strongly and regularly rounded; with numerous slightly-interrupted transverse carinæ, quite distinct through clothing; median line very feebly marked. *Elytra* subtrisinuate at base, sides rather suddenly narrowed at shoulders; with rows of large, round punctures, usually wider than interstices, but appearing very small through clothing; alternate interstices feebly raised. Basal segment of *abdomen* moderately concave in middle, the second flattened there. *Legs* stout; front coxæ rather widely separated. Front tibiæ strongly curved at apex. Length, 6½ mm.

Female. Differs in having prothorax narrower and elytra wider, abdomen convex, and tibiæ straighter.

Hab.—New South Wales: Windsor (A. M. Lea).

In general appearance very close to *piliventris*, but readily distinguished by the transverse sculpture of prothorax: from *Crawfordi* it differs in being larger, alternate interstices elevated, and abdomen densely clothed, with basal segment concave. All the tibiæ are also different.

MANDALOTUS NODICOLLIS, n. sp.

Blackish-brown, parts of antennæ and tarsi paler.

Rostrum very stout, carina quite concealed. Antennæ stout, especially the scape. *Prothorax* strongly transverse, base and apex truncate, sides rather feebly rounded; with large, round, isolated, and not very numerous granules of varying sizes. *Elytra* truncate at base; with large rounded or transversely suboblong punctures, usually wider than interstices; these rather feebly alternately raised. *Abdomen* with basal segment concave along middle and middle of apex.

Legs short and stout; front coxæ feebly separated; tibiæ (comparatively) feebly curved at apex. Length, 3-4½ mm.

Hab.—Queensland: Mackay, Darling Downs (C. French), Gayndah (G. Masters), Brisbane (A. Jefferis Turner), Townsville (H. H. D. Griffith).

Although there are twelve specimens before me, the scales of the upper surface are so uniformly covered with mud [3] that it is only in small spots that they can be seen; judging by these the clothing is very dense, and more or less greyish-white; but above the mud, stout, brown, almost perfectly erect setæ arise to a considerable height, both on prothorax and elytra. The under surface and legs are very densely covered with muddy-grey scales interspersed with numerous and rather thin whitish setæ. If the sexes are before me I am unable to distinguish them. The front coxæ are almost touching (with the clothing in position they appear to be in actual contact), the middle tibiæ are separated by a quite round tubercular elevation, but this is usually obscured by scales and mud. The granules of the prothorax, which are very distinctive of this species, and elytral punctures are entirely concealed before abrasion. With the exception of the following species, the scape is stouter than in any other known to me.

Mandalotus crassicornis, n. sp.

Black or dark reddish-brown, appendages paler. Densely clothed with light-brown scales, mottled in places. With fairly stout, rather sparse setæ, sparser on alternate interstices of elytra than elsewhere; under-surface with fine setæ. Tibiæ finely ciliated in male, but not in female.

Rostrum stout, carina covered with scales, but distinctly traceable throughout. Antennæ stout, scape very stout. *Prothorax* moderately transverse, sides strongly and regularly rounded; median line distinct: with numerous flattened, rounded, or irregular granules, clearly traceable through clothing. *Elytra* elongate-cordate, conjointly rather feebly arcuate at base; with rows of round punctures, distinctly narrower than interstices, and appearing very much narrower through clothing; alternate interstices feebly raised. *Abdomen* with basal segment gently concave in male, feebly convex in female. *Legs* stout; front coxæ feebly separated; front tibiæ feebly curved at apex. Length, 4½-4¾ mm.

Hab.—New South Wales: Sydney (on sea-beaches, Taylor Bros.); Queensland: Brisbane (A. Jefferis Turner).

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[3] I was not able to remove this without at the same time removing the clothing, even on soaking for several hours in water.

The intensity of colour, especially of the legs, varies, and one specimen is almost entirely red. The mottling of the scales consists of feeble dark spots on the elytra, and feeble, short, lateral stripes on the prothorax, but in only two out of five specimens are the markings at all distinct, whilst in one they are entirely absent. The scape is remarkably stout, at its widest being fully as wide as the space between the scrobes at the apex of rostrum, and much wider than the club; the femora are also much stouter than usual. The sexual differences are but slight.

MANDALOTUS FERGUSONI, n. sp.

Male. Black; appendages somewhat paler, tarsi distinctly paler. Densely covered with muddy-brown scales, variegated with small sooty spots. With short, stout, semi-erect setæ; under-surface with fine setæ in addition to scales. Front and hind tibiæ finely ciliated.

Rostrum with carina quite concealed. Antennæ moderately stout. *Prothorax* moderately transverse, sides strongly rounded; median line deeply impressed; with minute scattered granules entirely concealed by clothing. *Elytra* subtrisinuate at base; with large round punctures, much wider than interstices, but appearing much narrower through clothing; alternate interstices feebly raised. Basal segment of *abdomen* feebly concave in middle. *Legs* stout; front coxæ moderately separated; four front tibiæ rather strongly bisinuate, the hind pair strongly but obtusely bidentate internally. Length, 5 mm.

Hab.—New South Wales: Muswellbrook (E. W. Ferguson).

The posterior tooth of the hind tibiæ is just beyond the middle, is more obtuse than the other, and has a peculiarly-granulated appearance. Mr. Ferguson has sent three specimens as belonging to this species, the male described above and two females: the male is perhaps partially abraded of setæ, as on the females they are much more numerous, and being frequently white, both on the prothorax and elytra, they give the upper surface a peculiarly-speckled appearance. On the under surface of the females also the scales are denser and paler, and the setæ sparser and stouter, these, however, being common sexual variations. The females (which measure but 4 mm.) also have the basal segment of abdomen flat, the hind tibiæ edentate, and are more robust.

MANDALOTUS SETICOLLIS, n. sp.

Male. Blackish; appendages dull-red. Upper surface (except pronotum) densely covered with sooty-brown scales,

variegated with numerous spots of slaty-grey scales. Densely clothed with long, thin, semidecumbent setæ; shorter, thinner, and denser on under than on upper surface. Tibiæ very feebly ciliated.

Rostrum with carina uncovered throughout. Antennæ thin; first joint of scape more than once and one-half the length of second. *Prothorax* somewhat flattened, sides strongly rounded in front, rather feebly behind; with dense, more or less rounded and flattened, shining granules, not at all concealed. *Elytra* conjointly feebly arcuate at base; with punctures much narrower than interstices, and their size not much altered in appearance by clothing; interstices regular, with minute, scattered, depressed granules, and which are quite invisible before abrasion. *Abdomen* densely granulate; two basal segments largely and conjointly concave, apical strongly convex. *Legs* stout, with feeble granules; front coxæ rather widely separated; tibiæ feebly curved, but strongly inflated at apex. Length, 5½-6 mm.

Female. Differs in being more robust, basal segments of abdomen rather strongly convex, and the apical less so, and the tibiæ straighter.

Hab.—Tasmania: Ulverstone (on sea-beach. A. M. Lea).

Of the two males before me, one has the head, rostrum, and apex of prothorax diluted with red, in the other these parts are as dark as elsewhere; in the only female no part of the derm is quite black. The pale spots of scales on the elytra are very numerous, and from certain directions appear to form feeble, much-interrupted, transverse lines. On abrasion the head is seen to have small scattered granules. The median prothoracic line is present on the female, but absent from the males.

Readily distinguished from most species by the entire absence of scales from the pronotum, although the setæ there are as dense as elsewhere. In the table it is placed near *reticulatus*, but the two species have little in common.

Mandalotus similis, n. sp.

Male. Black; antennæ and tarsi dull-red, other parts of the legs very obscurely diluted with red. Densely covered with muddy-brown scales. With subdecumbent setæ, mostly brown, but in places straw-coloured. Front tibiæ with long and moderately dense ciliation, the others very feebly ciliated, all the femora with long pale hair.

Rostrum stout; carina rather feeble, but distinct throughout. Antennæ rather thin. *Prothorax* about as long as wide; median line very narrow; with minute scattered granules, quite concealed normally. *Scutellum* small but distinct.

Elytra rather feebly arcuate at base, rather strongly diminishing in width from basal fourth; with large round punctures, distinctly wider than interstices, but appearing much smaller through clothing; interstices regular. Basal segment of *abdomen* feebly concave. *Legs* stout; front coxæ rather widely separated; front tibiæ rather strongly curved at apex. Length, 4½ mm.

Female. Differs in being wider, punctures smaller, basal segment of abdomen rather strongly convex and tibiæ straighter.

Hab.—New South Wales: Forest Reefs (A. M. Lea).

In the only male before me the scales are quite uniform in colour, but in the female they are somewhat mottled, and the legs have feeble pale rings. The prothoracic sculpture is much as in *Fergusoni*, but the edentate hind tibiæ should prevent the two species from being confused together. In general appearance both sexes are much like those of *piliventris*, but the prothoracic granules are very different.

MANDALOTUS HUMERALIS, n. sp.

Male. Reddish-brown, appendages paler. Densely clothed with muddy-brown scales, and with rather sparse setæ. Front tibiæ very sparsely ciliated.

Antennæ rather stout. *Prothorax* moderately transverse, rather flat, sides strongly rounded; median line narrow; with numerous fairly large and rounded, but subobsolete, granules, not readily traceable through clothing. *Elytra* trisinuate at base, rather suddenly inflated behind shoulders, and thence rather strongly descreasing in width to near apex; with rows of large punctures, usually twice the width of interstices, or even more, but often almost or quite concealed; interstices feebly thickened in places. Basal segment of *abdomen* gently concave. *Legs* stout; front coxæ rather widely separated; front tibiæ rather strongly curved at apex. Length, 3¼ mm.

Female. Differs in being larger and wider, less angular in appearance, abdomen gently convex throughout, and tibiæ straighter.

Hab.—New South Wales: National Park (in rotting leaves. A. M. Lea).

In both specimens before me the scales are without variation, but in places are obscured by dirt, as is so frequently the case with species living in decaying leaves. The setæ of the upper surface are rather sparse and irregularly distributed, and vary in colour from whitish to dark-brown. One specimen has the rostral carina entirely concealed, but in the other it is distinct (almost certainly through abrasion) in the middle.

Although placed in the table with the species having the elytra non-tuberculate, these organs certainly appear slightly swollen in places on the disc. The male is a peculiarly-rough, angular insect, but the female is quite normal-looking, and rather strongly resembles the female of *hoplostethus*.

MANDALOTUS AVENACEUS, n. sp.

Male. Densely covered with muddy-brown, feebly-mottled scales. With subdecumbent brownish setæ. Front tibiæ rather sparsely ciliated.

Rostrum with carina distinct throughout. Antennæ rather thin. *Prothorax* feebly transverse, sides strongly and regularly rounded; median line distinct; with minute scattered granules, almost or quite invisible before abrasion. *Elytra* rather feebly trisinuate at base; subcordate; with rows of large rounded punctures, much wider than interstices, but appearing much smaller through clothing; interstices feebly alternately raised. *Abdomen* with basal segment gently concave. *Legs* stout; front coxæ rather widely separated; front tibiæ with a strong median ridge, ending posteriorly in a strong obtuse tooth. Length 3 mm.

Hab.—Victoria: Daylesford ("destroying oats." National Museum).

There are five specimens before me, but all are males; in most of them the elytra appear to be black, with the prothorax, antennæ, and tarsi reddish, and the other parts reddish-brown. The setæ, although fairly numerous, are very indistinct, except from the sides. The mottling on the prothorax appears to form very feeble stripes. In general appearance close to *arcuatus* and *trisinuatus*, but readily distinguished therefrom by the granules of prothorax, and the dentate front tibiæ.

MANDALOTUS ALBONOTATUS, n. sp.

Male. Black; under surface and appendages more or less red. Densely covered with muddy-brown scales, variegated in places with sooty and white or whitish scales. With stout semi-erect setæ, mostly dark-brown, but in places white or straw-coloured. Front tibiæ with rather short ciliation.

Rostrum with carina quite concealed, except at its tip. Antennæ thin. *Prothorax* rather feebly transverse, sides strongly rounded; median line distinct; with dense and fairly large but almost obsolete granules. *Scutellum* distinct. *Elytra* conjointly arcuate at base; with series of large, rounded punctures, the width of or wider than interstices, but apparently much narrower; alternate interstices feebly raised, the suture on its apical half more noticeably raised. *Abdo-*

men with numerous small granules, the basal segment somewhat concave. *Legs* stout; front coxæ widely separated; front tibiæ rather feebly bisinuate. Length, 4⅓-5 mm.

Hab.—Victoria: Apollo Bay (C. French).

The clothing of the under-surface (except at sides of sterna) consists entirely of rather fine setæ. On the five specimens before me there is always a distinct spot (or short stripe) of white scales on the third interstices at the base, and these are sometimes connected across the extreme base; the sides of the prothorax are usually marked with broken and irregular whitish stripes: there is also a distinct white spot at the side of each eye. The legs have more or less distinct whitish rings, usually two on each of the femora and tibiæ. The sooty scales may cover but a small portion of the derm or more than half. The prothoracic granules are scarcely traceable through the clothing, and when this has been removed are seen to be but very feebly elevated, and in fact the slight swellings should perhaps not be regarded as granules at all. The hind tibiæ at the lower inner edge are feebly ridged, and the ridge terminates rather suddenly at about one-third from the apex; but it is not distinct, and is quite invisible from most directions.

The two spots at the base of the elytra cause it to resemble several species, especially *simulator*, *carinativentris*, and *Blackmorei*, from all of which it may be distinguished by characters given in the table; *sterilis* [4] is apparently a narrower species, with the alternate interstices more strongly raised, and the abdomen and hind tibiæ different.

MANDALOTUS OCHREONOTATUS, n. sp.

Male. Of a dingy-brown; funicle, club, and parts of legs paler. Densely covered with sooty-brown scales, variegated in places. With stout, regularly-distributed, subdecumbent setæ, mostly dark-brown, but varying to white. Front tibiæ with rather short ciliation.

Rostrum much as in the preceding species. Antennæ somewhat stouter. *Prothorax* rather feebly transverse, sides very strongly rounded; median line very narrow, and usually concealed: with minute, scattered, and normally-concealed granules. *Elytra* conjointly arcuate at base: with series of large, rounded punctures, usually distinctly wider than interstices, but appearing much smaller through clothing: interstices regular. *Abdomen* with basal segment flat, or very slightly concave in middle. *Legs* strong; front coxæ moderately separated; front tibiæ moderately trisinuate. Length, 4½ (female, 5) mm.

[4] According to Mr. Blackburn's notes on the type in these "Transactions" for 1901, p. 27.

Female. Differs in being larger and wider, elytra more rounded, abdomen more convex, and tibiæ straighter.

Hab.—New South Wales: Muswellbrook (E. W. Ferguson).

More or less ochreous scales cover the rostrum, parts of the head, sides of the prothorax (and usually a small discal spot), and the fourth interstices near the base; the legs are feebly ringed, the rings varying from whitish to ochreous. Towards the apex of the elytra the scales are mottled-grey and sooty, the mottling variable. The spot on the fourth interstice of each elytron appears sometimes as a stripe confined to that interstice, and extending from the base to about two-fifths from the base; sometimes it appears in a more rounded and isolated form, and extends to the third and fifth interstices; and it varies considerably in size, but on the five specimens before me it is always present and sufficiently conspicuous. The prothoracic granules are much as in *similis*, from which species, however, it is readily distinguished by the ciliation of the front tibiæ of the male. The colours, both of derm and scales, are also different.

Mandalotus maculatus, n. sp.

Male. Black, appendages and apex of abdomen red. Moderately clothed with greyish and darker scales; legs feebly ringed. Setæ subdecumbent, rather sparse, and varying from white to dark-brown. Front tibiæ scarcely ciliated.

Rostrum with carina uncovered at tip only, but traceable throughout. Antennæ thin; club comparatively large. *Prothorax* flattened; moderately transverse, sides rather suddenly lessened towards base and apex; median line feeble; densely and rather coarsely punctured. *Elytra* rather indistinctly trisinuate at base, considerably wider than prothorax, sides subparallel to apical third; with series of large rounded punctures, about the width of interstices, but appearing much smaller through clothing; interstices feebly alternately raised. *Abdomen* with basal segment almost flat in middle. *Legs* stout; front coxæ touching; front tibiæ rather feebly trisinuate. Length, $3\frac{1}{2}$ mm.

Female. Differs in being more robust, basal segment of abdomen quite distinctly convex, and tibiæ straighter.

Hab.—Tasmania: Hobart, Mount Wellington, Bruni Island, Huon River (A. M. Lea).

In some specimens the apex of the rostrum and of the prothorax and the whole of the abdomen are more or less reddish. The clothing is less dense than usual, and the pale scales on the elytra appear as feeble spots; both shape and markings are very suggestive of *Desiantha maculata*. The prothoracic

punctures are greatly obscured before abrasion, and in places are replaced by rather feeble granules. The sutures of the third and fourth abdominal segments are deeper and wider than usual, but are the same as in the following species.

Mandalotus inusitatus, n. sp.

Male. Black; antennæ, tarsi, apex of tibiæ, base of femora, and the trochanters reddish. Moderately clothed with greyish and darker scales. With fairly numerous semi-erect, and mostly dark, setæ. Four front tibiæ rather feebly, the hind rather strongly, ciliated.

Rostrum with carina uncovered on apical half. Antennæ thin. *Prothorax* flattened in middle, moderately transverse, sides strongly rounded; median line absent; with numerous granules scattered about amongst punctures, both more or less concealed normally. *Elytra* conjointly arcuate at base; with series of punctures narrower than interstices on basal half, and much narrower posteriorly, and usually almost or quite concealed: interstices very feebly alternately raised, and with minute, scattered, concealed granules. *Abdomen* with basal segment gently concave. *Legs* stout, especially the front femora; front coxæ touching; front tibiæ rather strongly bisinuate below, and thinner than usual. Length 3 (female, $3\frac{3}{4}$) mm.

Female. Differs in being stouter, basal segment of abdomen gently convex, and the front tibiæ shorter and straighter.

Hab.—Tasmania: Hobart, Mount Wellington, Stonor, Huon River (under logs. A. M. Lea).

In general appearance close to the preceding species, but with the club darker, the elytral spots absent or less distinct, and the setæ more numerous and more erect. But it may be readily distinguished from that, and from all other species known to me, by the ciliation of the hind tibiæ being much stronger than that of the front pair, a character which is also not confined to the male (I can be certain of this, having taken a pair *in cop.*). In two specimens there are feeble rings on the femora, but these are not traceable in nine others. Specimens are usually very muddy when obtained.

Mandalotus Blackmorei, n. sp.

Male. Reddish-brown or black; antennæ, tarsi, and other parts of legs paler than elsewhere. Densely covered with muddy- or sooty-brown scales, more or less variegated with whitish or blackish scales. With moderately dense, subdecumbent setæ, frequently white, but varying to dark-brown.

Rostrum with carina uncovered throughout. Antennæ rather thin. *Prothorax* very feebly transverse, sides strongly

rounded; median lines and granules very feeble. *Elytra* conjointly arcuate at base; with series of large round punctures, about the width of interstices, but appearing much smaller through clothing; interstices regular. *Abdomen* with basal segment gently concave. *Legs* stout, especially front femora; front coxæ moderately separated; front tibiæ moderately bisinuate beneath. Length, $4\frac{1}{4}$-$4\frac{3}{4}$ mm.

Female. Differs in being more robust, abdomen convex throughout, tibiæ straighter, etc.

Hab.—New South Wales: Forest Reefs (Albert Blackmore and A. M. Lea).

The derm of the elytra, the throat, and other parts of the under surface are sometimes quite black; but as a rule these parts are of a dark-brown, although usually darker than elsewhere; the prothorax is very rarely black. The scales are often rather strongly variegated, and there is usually a distinct white spot on the third interstice at base, and also at the side of each eye, somewhat as in *albonotatus*. On some specimens the scales are almost entirely dark, with more or less conspicuous whitish spots. The clothing of the abdomen consists of rather dense setæ, but with scales at the sides of the two basal segments. The front coxæ are very distinctly separated, but the distance between them is less than in most species, and is less in the male than in the female. It is, however, slightly more than in *pallidus* and *suturalis*, which species have been referred to another section in the table.

The prothoracic granules, although individually rather large, are quite invisible before abrasion, and are even more feeble than in *albonotatus;* in fact, from some directions the prothorax, even after abrasion, appears to be without them, but in certain lights very fine lines can be seen marking their edges; *albonotatus*, which it strongly resembles, has the prothorax larger, with a more distinct median line, the front coxæ more, and the middle coxæ much more, widely separated. the abdominal clothing sparser; and is altogether more robust. The mandibular appendages are present on one female before me, and are long, thin, and curved, much as in many species of *Leptops*.

SUB-FAMILY EURHYNCHIDES.

Ctenaphides gymnostictus, n. sp.

Female. Dark reddish-brown. Densely covered with whitish setæ-like scales, almost uniform in distribution, except that the apical half of the rostrum is nude, and that there are nude spots forming rows on the alternate interstices of the elytra, the spots being more numerous on the sutural interstice than on the others.

Head with numerous and rather coarse, but partially-concealed, punctures; ocular fovea narrow and elongate. *Rostrum* rather thin, almost twice the length of head, feebly increasing in width to base and apex, rather coarsely punctured throughout, and with a very feeble median carina on the basal half. Antennæ inserted almost in exact middle of sides of rostrum, first-sixth joints subcylindrical, second slightly longer than third, and thinner, but not much shorter than first, seventh-eighth subtransverse, shorter and wider than the preceding joints, ninth-eleventh still wider and forming a club, the length of which is equal to the six preceding joints combined, eleventh as long as eighth-tenth combined. *Prothorax* feebly transverse, strongly convex, sides strongly rounded, but with somewhat sinuous outlines; with dense and rather coarse, but partially-concealed, punctures. *Elytra* about four times the length of prothorax, parallel-sided to near the apex, strongly convex, interstices rather strongly elevated, the alternate ones somewhat wider than the others: striæ with fairly large, but more or less concealed, punctures. *Under surface* with dense, rather small, and partially-concealed punctures. *Legs* rather short. Length (including rostrum), 22 mm.

Hab.—Western Australia: King George's Sound (type in Macleay Museum).

In general appearance something like the female of *Eurhynchus lævior*, but differs in being larger, prothorax much wider, rostrum straighter, second joint of antennæ longer, instead of shorter, than third, etc.

There are two specimens (sexes) of this species in the Australian Museum; the male differs from the female in being smaller, with the rostrum shorter, stouter, and more coarsely punctured. The antennæ are inserted closer to apex of rostrum, the second-ninth joints are provided with wide, flange-like extensions, rather than rami, the tenth is also produced, but in profile appears triangular (the second-tenth on the produced parts are hairy), the eleventh is almost the length of the three preceding combined, narrower than any of the others, and constricted and strongly curved just before the middle. The extensions of the antennæ are much shorter than in *porcellus*, and are longest at about the middle, instead of gradually elongating to the ninth, the eleventh is longer than in *porcellus*, but otherwise much the same.

This genus has hitherto been known only from the male of *C. porcellus;* but the examination of both sexes of the present species suggests to me the possibility that *Ctenaphides* should be regarded as a subgenus of *Eurhynchus* only. There are certainly no generic features by which the females of it and of *Eurhynchus* can be distinguished.

SUB-FAMILY CIONIDES.

Nanophyes.

The peculiar shape and five-jointed funicle render this genus a very distinct one: hitherto but one species has been recorded from Australia.

Nanophyes maurus, Pasc.

There is a specimen before me, from Sydney, which possibly belongs to this species; it differs from the description, however, in having the scape and basal joint of funicle (not flavous, but) of a very dark red, the base and apex of tibiæ are similarly coloured, and the sides of the prothorax in certain lights appear to be diluted with red.

Nanophyes Alleni, n. sp.

Male. Black; base of femora flavous; funicle, scape, base and apex of tibiæ and parts of tarsi of a more or less dull red. Moderately clothed with whitish pubescence, denser on sides of sterna than elsewhere.

Rostrum thin, not quite as long as head and prothorax combined, grooved behind antennæ (which are inserted at apical third) and dilated in front of them, with punctures throughout. *Prothorax* transverse, sub-conical; with sparse partially-concealed punctures. *Elytra* punctate-striate, the interstices regularly convex, and with indistinct punctures. *Femora* bidentate, the large tooth very thin and sharp, the smaller scarcely traceable. Length (excluding rostrum), 2 mm.

Female. Differs in being larger, rostrum fully the length of head and rostrum combined, grooves less distinct, and punctures smaller and sparser, especially towards the apex; the antennæ also are inserted nearer to the middle.

Hab.—Queensland: Cairns (Edmund Allen).

Differs from the preceding species by its slightly larger size, longer rostrum, and very decidedly longer femoral teeth. The clothing on the elytra of five specimens shows no tendency whatever to form a V.

Nanophyes V-notatus, n. sp.

Female. Black; base of femora flavous, tibiæ almost flavous, but slightly infuscate in middle; scape, funicle, and parts of tarsi of a dull red. Clothed with greyish pubescence, denser on sides of sterna than elsewhere, and forming a distinct V on elytra.

Rostrum thin, the length of head and prothorax combined, with a few feeble punctures in front of antennæ (which are inserted at apical two-fifths), but with distinct

punctures and grooves behind. *Femora* as in the preceding species. Length, 2 mm.

Hab.—New South Wales: Nepean River (A. J. Coates), Sydney (H. J. Carter).

Readily distinguished from *maurus* and *Alleni* by the white elytral V; the arms of this commence near each shoulder and become conjoined on suture before the middle. A somewhat abraded male, evidently belonging to this species, differs in having the rostrum shorter, stouter, more coarsely punctured, and with the antennæ inserted closer to the apex.

I have not described the prothorax and elytra in this and the two following species, as they are much the same as in *Alleni*.

NANOPHYES NIGROVARIUS, n. sp.

Flavous, in places becoming dull-red; head, club, meso- and metasternum and abdomen black or blackish, base of rostrum and funicle more or less infuscate. Clothed with whitish pubescence, denser on sides of sterna and of abdomen than elsewhere, and with a tendency to form a V on the elytra.

Rostrum and antennæ of both sexes much as in *Alleni*, and *femora* the same. Length, 2-2¼ mm.

Hab.—New South Wales: Nepean River (A. J. Coates), Clarence River (A. M. Lea).

The elytral V is in the same position as in the preceding species, but is not quite so pronounced.

A specimen from Brisbane is probably a variety; it differs in being dull red, in having the rostrum entirely black, the suture black at the base (in one of the types it is infuscate at the base), and the sides of the elytra and middle of femora infuscate.

NANOPHYES PALLIDICORNIS, n. sp.

Female(?). Flavous; in places slightly reddish or slightly infuscated. Sparsely clothed with greyish pubescence, and forming a feeble V on elytra.

Rostrum thin, parallel-sided, slightly longer than prothorax, with grooves and punctures behind, and a few punctures in front of antennæ, these inserted at apical two-fifths. *Femora* very feebly bidentate. Length, 1½ mm.

Hab.—New South Wales (Macleay Museum): Forest Reefs (A. M. Lea).

Smaller and wider than any other species tabulated below. The pale club and under surface will readily distinguish it from *nigrovarius;* the elytral V is no more conspicuous than in that species, but on one of the specimens there is a faint row of slightly-darkened spots before and another

behind it; on the second specimen the posterior spots are wanting.

Prothorax and elytra black.
  Elytra with pubescence forming a distinct V ... ... *V-notatus*, n. sp.
  Elytra without such a V.
    Femoral dentition feeble ... ... *maurus*, Pasc.(?)
    Femoral dentition acute ... ... *Alleni*, n. sp.
Prothorax and elytra not black.
  Sterna and abdomen more or less black ... *nigrorarius*, n. sp.
  Sterna and abdomen pale ... ... *pallidicornis*, n. sp.

New Australian Lepidoptera, with Synonymic Notes.—No. XXIV.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read July 2, 1907.]

RHOPALOCERA.

LIBYTHEIDÆ.

* Libythea geoffroyi, Godt.

Enc.: Meth. ix. Suppl. p. 813 (1823); Wallace, Trans Ent. Soc., 1869, p. 335, n. 4. *L. nicevillei*, Oll., P.L.S., N.S.W., 1891, p. 28.

This insect is comparatively rare in Australia, and I have seen but two females. The male, however, is not so rare. The sexes are very dissimilar, the male being tawny-yellow, with several large semi-transparent wing-spots, whilst the female is a beautiful lilac-blue, almost devoid of markings. Having recently received a female from North Queensland, I thought it would be wise to correct the nomenclature. The male varies somewhat, and is known under the various names of var. *antipoda*, Boisd., var. *ceramensis*, Wall, and var. *Batchiana*, Wall. It has a range extending to Ceram, Batchian, New Caledonia, etc. I have not yet heard of it being taken in New Guinea, although it should occur there.

Telesto monotherm, n. sp.

Female, 40 mm. Head dark fuscous, spotted with ochreous-white. Post-orbital rims whitish. Antennæ fuscous, faintly spotted with ochreous-whitish. Palpi fuscous, beneath whitish. Legs dark fuscous, posterior tibiæ whitish. Abdomen fuscous, ringed narrowly with ochreous-white, beneath more whitish. Forewings rather elongate triangular, costa slightly arched towards base; dark fuscous, without markings; cilia dark fuscous. Hindwings with termen rounded; colour and cilia as in forewings, basal hairs orange; a narrow median band of orange not near reaching either margin. Underside of forewings dark fuscous, paler on dorsal half; an oblique row of four somewhat confluent whitish dots, from costa at three-quarters; a moderate, short, whitish fascia, from costa near apex to vein four, narrow on costa and much dilated on lower half, both edges scalloped: a small whitish spot on costa just before fascia; a row of whitish dots along termen. Hindwings whitish, markings blackish: an oval spot on costa close to base: two similar on costa just before middle, only separated from each other by vein; two others, much smaller, placed one below the other, immediately below costa at three-quarters: a roundish spot in cell, a larger one at posterior end, and an elongate one lying below lower edge of cell near base; three

*In Miskin's Catalogue this insect is called *L. myrrha*, Godt.

somewhat cartridge-shaped spots, separated by veins in disc at two-thirds from base in a line with those on costa at three-quarters; a very large darker spot between veins one and two, almost touching an elongate dorsal patch of fuscous: an irregular row of spots along termen median, two largest, absent between veins five and six; cilia fuscous chequered with whitish.

Kuranda (Dodd) and Mareeba (Stewart), North Queensland. Two specimens; in September and October.

ERYNNIS AMALIA, Semp.

Pamphila amalia, Semp. Mus. Godf., Lep. xiv., 1878; *Hesperilla fulgidus*, Misk., P.R.S.Q., 151, 1889; *Erynnis fulgida*, M. and L., T.R.S.S.A., 116, 1902.

With the assistance and generosity of Col. Chas. Swinhoe, M.A., and Prof. K. Kraepelin, of the Hamburg Museum, I have been enabled to recognize this species. The former sent me an admirable drawing, the latter an excellent description.

HETEROCERA.

ARCTIADÆ.

SPILOSOMA (?) COSMETA, n. sp.

Male, 30 mm. Head and thorax dull ochreous. Palpi and antennæ black. Legs orange-ochreous, tibiæ and tarsi fuscous. Abdomen orange or reddish-orange, a dorsal and lateral series of dark fuscous spots throughout. Forewings elongate, moderate, costa nearly straight, termen rounded, oblique; dull ochreous, with blackish markings, all veins more or less outlined with fuscous; three dentate, moderately-thick fasciæ; first from costa at about one-quarter to one-quarter (inner margin), curved outwards and slightly angulated above middle; second similar from costa beyond middle to inner margin at middle; third much thicker and better defined, from costa at five-sixths to anal angle; a suffused discal dot between first and second fasciæ, sometimes obscure; a moderately-broad, blackish band along termen, not quite reaching anal angle; containing half-a-dozen elongate streaks of ground-colour on veins; cilia dark fuscous. Hindwings with termen round; pale orange-yellow; a moderately large black discal dot; a broad blackish band along termen, containing a small patch of ground-colour in middle; cilia orange-yellow, on apical half fuscous.

Broken Hill, New South Wales. Several specimens; in May.

This species closely resembles *S. fuscinula*, but is very constant, and is at once recognized by the shorter pectinations of the antennæ. I am very strongly inclined to think that the female will prove to be apterous, as during many years of searching I have never met with anything but male specimens,

and I have searched for the female in vain. Should this prove to be so, then a new genus will be required to receive it.

GEOMETRINA.

MONOCTENIADÆ.

Hypographia eremœa, n. sp.

Male, 30 mm. Head, palpi, thorax, and legs ashy-grey-whitish. Abdomen ochreous. Antennæ fuscous. Pectinations ochreous-fuscous. Forewings elongate moderate, somewhat triangular, costa nearly straight, termen oblique, rounded; ashy-grey-whitish; a waved, angulated, black line from costa at one-third to inner margin at one-third; a second, similar, from costa at five-sixths to inner margin at two-thirds; a black line along termen, interrupted at extremities of veins; cilia cinerous-grey, with blackish points at extremities of veins. Hindwings with termen rounded; whitish; a pale fuscous band along termen, edged above by two waved, parallel, pale-fuscous lines, which reach both margins, but become blackish on dorsum, as also does the band along termen; cilia white with fuscous spots at extremities of veins.

Townsville, Queensland. Two specimens, from Mr. F. P. Dodd; taken in January.

SELIDOSEMIDÆ.

Amelora polychroa, n. sp.

Male, 30 mm. Head and face whitish. Thorax whitish mixed with ochreous and ferruginous fuscous, antennæ ochreous, pectinations ochreous, six. Abdomen pale ochreous. Legs pale whitish-ochreous, tibiæ and tarsi banded with blackish. Forewings elongate-triangular, termen bowed-oblique; dull-whitish, thickly and irregularly strewn with blackish, ferruginous and fuscous scales, which form an irregular outwards-curved fascia from costa at one-quarter to dorsum at one-quarter; a moderately straight, dentate-edged, fuscous fascia from costa at five-sixths to near anal angle, preceded by a larger quadrate, fuscous, discal dot; an irregular fuscous sub-terminal line; all veins more or less outlined with ferruginous-ochreous; cilia white, barred with fuscous between veins. Hindwings whitish, terminal half more or less irrorated with light ferruginous scales, becoming thicker on terminal portion; a pale fuscous discal spot; cilia white. Probably nearest *arotræa*, Meyr.

Derby, Western Australia. Two specimens; in November.

PYRALIDINA.

GALLERIADÆ.

Melissoblaptes spodoptera, n. sp.

Female, 16 mm. Head, thorax, and antennæ dull grey-whitish. Abdomen greyish-ochreous. Legs greyish. Forewings elongate, moderate, costa moderately arched, termen

rounded, oblique; dull whitish, irrorated with light fuscous, somewhat more pronounced in cell and on costa; an outwards-curved, fuscous line from costa at two-thirds to dorsum at two-thirds; a row of fuscous dots along termen; cilia grey-whitish, with a fuscous median line. Hindwings and cilia grey.

Townsville (Dodd) and Cooktown. Four specimens; in September and August.

MUCIALLA LEUCOSPILA, n. sp.

Male, 15 mm. Head and thorax ashy-grey-whitish, mixed with some ferruginous ochreous-scales. Antennæ fuscous. Legs and abdomen grey-whitish. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; ashy-grey-whitish, more or less irrorated with fine blackish scales and scattered ferruginous scales; an obscure ferruginous patch, at patch followed by a whitish spot on costa at one-fifth; a fine, irregular, fuscous line from costa beyond white spot to dorsum at one-third, indented above dorsum, a similar but very suffused line from costa at five-sixths to dorsum at anal angle; one or two fine black marks at end of cell; three blackish spots on costa near apex; a row of suffused fuscous spots along termen; cilia grey, becoming fuscous on terminal half. Hindwings light fuscous; cilia greyish, becoming fuscous on terminal half.

North Queensland. One specimen.

MUCIALLA MACROMORPHA, n. sp.

Male, 20 mm. Head, palpi, and thorax dull-reddish-fuscous, thickly sprinkled with dull white. Abdomen grey. Antennæ grey. Legs and abdomen grey-whitish. Forewings elongate, moderate, costa hardly arched, termen rounded, oblique; dull reddish-fuscous, thickly irrorated with very minute whitish and black scales; veins very obscurely outlined with darker towards termen; cilia dull reddish-fuscous, with a fuscous sub-basal line.

North Queensland. One specimen.

MUCIALLA CRYPSIMERA, n. sp.

Male, 16-18. Head, palpi, thorax, and antennæ ashy-grey-fuscous. Legs grey, abdomen silvery-grey. Forewings elongate, moderate, costa gently arched, termen rounded, oblique; ashy-grey-fuscous, sometimes thickly mixed with whitish, all veins more or less outlined in black, sometimes obscure; indications of two fuscous fasciæ somewhat oblique, both reaching from costa to fold at middle and two-thirds; a row of more or less confluent fuscous spots along termen; cilia ashy-grey, with fuscous submedian and subterminal lines. Hindwings grey, tinged with fuscous; cilia grey, with a fuscous sub-basal line.

North Queensland. Two specimens; in March.

Notes on South Australian Decapod Crustacea Part V.

By W. H. Baker.

[Read July 2, 1907.]

Plates XXIII. to XXV.

The species here dealt with are of a very varied character, and several of them are submitted with a good deal of diffidence. The two species of *Pinnoteres* are established chiefly on the fact of the absence of the dactylus of the external maxillipeds. I have not attempted to figure *P. subglobosa*, on account of its untoward shape; it would appear to be deeper sunken in parasitism than other members of the same genus.

With regard to the two species of *Processa*, while they are sufficiently distinguished from each other, I must confess that I have not been able to compare them with any foreign species.

Very few species of the actively-swimming crustacea are known from the southern coast of Australia, there not having been any systematic attempts to collect them. We are looking forward to results from the efforts which are about to be made by the Federal Government in the direction of trawling.

I wish to express my sorrow at the death of Mr. F. E. Grant, F.L.S., of Sydney, which took place in January last. I owe him for many good services, especially in relation to references I could not make myself.

Order BRACHYURA.

Tribe CYCLOMETOPA.

Family Xanthidæ.

Sub-Family Xanthinæ.

Genus *Cycloxanthus (?)*, A. Milne Edw.

Cycloxanthus (?) carinatus, n. sp. Pl. xxiii., fig. 1.

The body is almost totally glabrous.

The carapace is considerably broader than long, not very convex, the surface is uneven, the regions very indistinctly indicated, covered with numerous minute punctations amongst which larger pits are scattered, which are more numerous on the antero-lateral margins and the front.

The front is more than one-third the width of the carapace; it is strongly arched, lamellar, cristate, and projects

far beyond the eyes, and is transversely sinuate and obliquely depressed; its outer ends have distinct closed incisions, but there is no sign of a median notch.

The antero-lateral margins are arcuate, much longer than the postero-lateral, cristate, thin, and divided into four lobes by distinct notches. The postero-lateral margins are concave and much converging, making the sharply-accentuated posterior margin narrow.

The sub-orbital and pterygostomial regions are granular, as also is the epistome and basal joints of the antennæ.

The sternal plastron is punctated.

The pleon of the male is narrow, five-segmented, the first two segments occupying all the space between the last pair of legs, the three coalesced segments are wider at the base and tapering, the last segment is a small truncated triangle.

The orbits are oval, rather small, with two closed incisions above and one below near the exterior angle, the internal sub-ocular angle is only slightly accentuated. The ocular peduncles are much curved, do not fill the orbits, and each has a small tubercle close to the eye.

The fossettes are slightly oblique beneath the strongly over-arching front; the basal joint of the antennule has a strong oblique lip-like ridge.

The epistome is narrow and sunken, anteriorly it is continuous with the interantennulary septum, an oblique line traverses it from the bases of the antennæ, becoming obliterated medianly.

The basal joint of the antenna is very oblique and tightly wedged in between the sub-frontal thickening and the subocular region, its distal anterior half is cut away on account of this thickening, the end reaches the sub-ocular angle. The remaining joints and the flagellum are very small and lie in the orbit.

The buccal frame is subquadrate, its anterior margin is somewhat arched and is somewhat sunken, dipping a little in the middle; it has a median and two lateral closed incisions.

The external maxillipeds completely close the buccal orifice. The merus is granular, with a depression on the external surface, subquadrate, with the internal distal angle truncated and the distal margin slightly oblique; it is about half as long as the ischium, the division-line between them having an insinuation; the ischium is less granular and somewhat punctate, and has a longitudinal groove. The exopod nearly reaches the external angle of the merus.

The chelipeds are robust, the merus is trigonous, not reaching as far as the margin of the carapace; its upper edge bears some irregular tubercles and a few coarse hairs. The

carpus is rounded above; its surface, like the upper surface of the palm, is strongly reticulate, caused by anastomosing strings of densely-packed granules and pits; there is a small tubercle on the inner angle. The palm is moderately compressed, rounded externally, and abruptly declivous and smooth internally, carinate above and below. The fingers are strongly compressed and carinate, the immobile one is strongly toothed, the mobile one less so, there is a small hiatus between them, they are slightly hooked, and not excavated at the tips.

The ambulatory legs are much shorter than the chelipeds, the joints much compressed, expanded, and carinate, the meri are trigonous, the dactyli are straight, five or six carinate strongly, with the claws sharp and slightly curved.

Length of carapace, 20 mm.
Breadth „ „ 26 mm.
Length of cheliped, 25 mm.
„ „ first leg, 21 mm.

Males only, from Port Willunga, Mr. W. J. Kimber, Port Lincoln.

C.(?) punctatus, Haswell, which does not bear a detailed description, differs from the present species in the following points:—The carapace is more convex and polished, with the regions more strongly defined: the front and antero-lateral margins are much thicker and not cristate, and there are no incisions on the outer ends of the front: this also projects rather more, and is slightly pointed. An oblique and sinuous groove extending from the second antero-lateral notch across to the strong depression behind the gastric region is well-marked. The posterior margin is thickened, without being sharply defined. The subocular regions are nearly smooth; the sternal plastron much more deeply pitted. The merus of the external maxillipeds is about one-third the length of the ischium, with the distal margin much more oblique; the merus also is nearly smooth, marked with a narrow pit externally. The groove of the ischium is nearly obsolete. The chelipeds are nearly smooth in comparison, and not carinate. The ambulatory legs are scarcely compressed, and non-carinate, while the dactyli are sub-cylindrical, being marked with longitudinal lines of pits, the interspaces between which, however, may assume a carinate form.

I agree with Messrs. Fulton and Grant (Proc. Roy. Soc. Victoria, 19 N.S., pt. i., p. 6) that this species should not be retained in the genus *Cycloxanthus*, but am unable to agree that its place is in *Lioxantho*, Alcock—where they doubtfully put it—not being able to examine any species of that genus.

Tribe CATAMETOPA.

Family GONOPLACIDÆ.

Sub-family, RHIZOPINÆ.

Genus *Ceratoplax*, Stimpson.

Ceratoplax punctata, n. sp. Pl. xxiii., figs. 2, 2*a*, 2*b*.

Body rather thick.

The carapace is broader than long, very convex in the antero-posterior direction, much less so in the transverse; smooth, polished, and, except on the margins, glabrous with scattered pits; two of these, situated about the middle, and rather distant apart, are more conspicuous, and below them is a faint marking of a broad H in pits; behind this, on each side of the intestinal region, is a small area of wrinkles.

The front is almost vertically depressed, less than one-third the width of the carapace rounded at the external ends, and medianly a little insinuate and slightly notched. The antero-lateral margins are slightly cristate, obscurely lobed by two or three faint notches, shorter than the postero-lateral margins. Postero-lateral margins nearly parallel. Posterior margin broadly arcuate and raised to a ridge. Except on the posterior margin the carapace has a dense fringe of long cilia, which traverses the ocular peduncles; beneath the fringe the surface is more or less granulate. The orbits are moderately large and excavated into the upper surface; they are also somewhat elongated. The ocular peduncles almost completely fill them, and are levelled off to be nearly flush with the sub-ocular surface; the internal sub-ocular angle is not produced. The eye is narrow and slit-like.

The antennules which fold transversely are partially hidden by the front.

The basal joints of the antennæ close the hiatuses of the orbits and extend beyond the sub-ocular angles, but scarcely reach the front; the second joints extend a little beyond the front.

The epistome is narrow—transverse.

The sub-ocular and pterygostomial regions are slightly concave or flat.

The external maxillipeds are very hairy and almost close the buccal orifice; the ischium is slightly sulcated longitudinally and jointed to the merus obliquely-straight. The merus is sub-quadrate, with its internal distal angle not much truncated, the distal margin slightly insinuated; much produced with a rounded lobe at the external distal angle, that portion covering the end of the exopod. The succeeding joint is articulated at the inner angle of the merus. The exopod is broad.

The chelipeds are short, equal, and densely hairy on the margins. The merus has a small tubercle on the upper margin. The carpus has the internal angle obtusely projecting, with a small area of granules close to it on the upper surface. The hand is short, very much compressed, its external surface marked by a few rather coarse granules inclined to become spinuliform; the lower margin is strongly carinate, the carina granulate, the upper margin is obtuse. The fingers are much compressed, shorter than the palm, not meeting, except at their tips, the mobile one sulcate, and with a cluster of granules above at the proximal end; the immobile one slightly toothed.

The ambulatory legs are moderately long, longer than the chelipeds; the first pair is shorter than the others, these being sub-equal in length; all the exposed margins of the joints are densely hairy; the propodi have longitudinal sulcations and some pits on their anterior and posterior surfaces; the dactyli are stiliform, and rather shorter than the propodi, almost totally covered with short fur and some long hair.

The pleon is fringed as the other parts, and scarcely pitted; seven-segmented, the basal segments not nearly covering the sternal plates; the first segment is drawn out to a point on each side, and the terminal one shovel-shaped.

Length of carapace, 12 mm.
Breadth „ „ 16 mm.

One female in the museum collection, which I describe as belonging to the southern coast, on the strength of having received from Mr. H. Flecker a carapace, which undoubtedly belongs to it, from Edithburg, the type I received from the Museum; locality doubtful.

Family, PINNOTERIDÆ.

Sub-Family, PINNOTERINÆ.

Genus, *Pinnoteres*, Latreille.

Pinnoteres holothuriensis, n. sp. Pl. xxiii., figs. 3, 3*a*.

The integument is of firm consistence.

The carapace is broadly ovate or subcircular, smooth, glabrous, convex in both directions, with the regions not defined, ornamented with dark lines, which are chiefly meridional, which extend below to the lateral regions, slightly depressed between the gastric region and the front, also in the metabranchial regions. Front advanced a little beyond the eyes, about one-third the width of the carapace showing arcuate above but depressed to a V shape between the fossettes. Lateral margins faintly defined.

The sternal plastron is hairy at the border, which limits the end of the pleon, and at the bases of the chelipeds.

The pleon of the male slightly tapers from the third segment, the second segment is very short, the last four subequal in length. The pleon of the female is fringed with hairs.

The orbits are circular, completely filled by the ocular peduncles. The eyes are well pigmented.

The fossettes are subcircular, large, and occupy almost all the interocular space, there being a very thin septum between each.

The antennæ are very small.

The epistome is narrow, transverse, and a little sunken.

The buccal frame is transversely broad; its upper margin shows four shallow arches with a small median V-shaped point.

The external maxillipeds are slightly pubescent, and are without sutural line in distinguishing the ischium from the merus; they completely close the buccal cavity. The palp consists only of the carpus and propodus, there being no dactylus; the propodus is hatchet-shaped, and the carpus has on the inner side a tuft of hair at the distal end, which reaches nearly to the end of the propodus. The exopod is compressed and hidden.

The chelipeds are well developed in both sexes, longer than the legs, unarmed, smooth; the merus is trigonous, the carpus is rounded above with a tuft of short hairs at the inner angle, the palm is scarcely compressed, vertically narrow at the proximal end, the upper margin ascending to the base of the mobile finger, it is hairy on the lower border. The fingers are nearly as long as the palm, not gaping, curved, or hooked at the tips, especially the mobile one, minutely toothed on the inner margin, with one or two larger teeth.

The ambulatory legs are scarcely compressed, unarmed, and not different notably in length; the carpi and propodi of the second and third pairs with a fringe of hairs on the lower margins, and the propodi with a fringe near the upper margins, continued on the posterior surfaces of the carpi in an oblique line, the first and last pairs are less hairy. The dactyli are rather short, strong, curved, with sharp, slender claws, and more or less hairy on their inner margins.

Specimens found inside holothurians and ascidians; those from ascidians are smaller, but without specific difference. This crab is able to swim, and probably does not spend all its time within the host.

Length of carapace, 10 mm.

„ of cheliped, 11 mm.

Dredged by Dr. Verco, 12 fathoms, St. Vincent Gulf. Ascidian specimens from 5 fathoms.

Pinnoteres subglobosa, n. sp.

The body is soft, subglobose, or slightly quadrate owing to the swollen body, the pleon loaded with ova having a greater bulk than the thorax, destitute of hairs except on the margin of the sternal plastron, which limits the pleon anteriorly, and a few on the lower margins of the palms of the chelipeds.

The carapace is very convex, much depressed anteriorly, the front truncate, and very scarcely in advance of the eyes, nearly straight and less than one-third the width of the carapace. The pleon is very large and cup-like, and slightly umbonate medianly.

The orbits and fossettes are smaller than those of the preceding species, and the septum between the fossettes is thicker.

The eyes are almost destitute of pigment.

The buccal frame and external maxillipeds also are similar in shape to the preceding species, except that in the maxillipeds the propodus is less expanded and setose, the dactylus also is wanting.

The chelipeds are slender, not much more robust than the ambulatory legs, scarcely compressed; the merus is cylindrical and curved, the carpus not much shorter than it, the palm widens slightly in the vertical direction towards the distal end. The fingers are rather more than half as long as the palm, slightly gaping, scarcely hooked, with very small teeth, and one or two larger ones near the proximal ends.

The ambulatory legs do not differ much in length, the first pair is rather shorter than the chelipeds, the dactyli are strongly curved.

The ova are small and very numerous.

This species was found in pectens.

Dredged by Dr. Verco, 17 fathoms, S.A. coast.

Order, BRACHYURA, PRIMIGENIA, or DROMIACEA.

Tribe, DROMIIDEA.

Family, Dromiidæ.

Genus, *Dromia*, Fabr.

Dromia octodentata, Haswell. Pl. xxiii., fig. 4.

Dromia octodentata, Haswell, Cat. Aust. Crust., p. 140.

I find in this species that the characteristic teeth of the antero-lateral border are variable in position, and that frequently there is an extra tuberculiform tooth just anterior to the last, but in the same slightly-curved line with the others.

The body is covered with a very harsh tomentum of barb-

ed hairs, and is indeed very hirsute on the chelipeds and legs in large specimens; the hairs are, however, very scanty on the carapace, and when rubbed off leave the surface polished and marked with minute pits.

The carapace is pentagonal in outline and very convex; there is a slight median groove extending from the front a little back, and another wider and oblique proceeding from the interval between the external angle of the orbit and the first antero-lateral tooth. In some specimens a longitudinal indentation exists on each side of the cardiac region, but the cervical groove is very indistinctly marked.

There is a tooth about the middle of the upper orbital border and another close to the external angle, the angle itself is occupied by a V-shaped notch.

Two teeth are on the external angle of the buccal frame, the anterior one of which is covered with granules.

The epistome is sunken.

The basal joints of the antennæ lie slightly obliquely towards the middle line.

The internal margins of the ischium and merus of the exterior maxillipeds bear a row of granules or spinules.

A rather common species. S.A. coast.

Genus, *Dromia*, Fabr.

Sub-genus, *Cryptodromia*, Stimpson.

Cryptodromia depressa, n. sp. Pl. xxv., figs. 1, 1*a*, 1*b*.

The body has a harsh, short, brown tomentum, which is spare or absent on the surface of the carapace and exposed parts.

The carapace is slightly broader than long, subpentagonal in outline, a little uneven behind, with the cervical groove well marked, smooth, except for a few small tubercles near the antero-lateral borders and orbits. The front is composed of two prominent obliquely compressed processes with a median one, which is small, depressed, and obtuse, not visible from above; there is a supra-orbital tooth and another at the external angle of the orbit. The antero-lateral margins are arched and somewhat cristate—being a little excavate underneath—nearly in the same line with the orbital and frontal teeth when viewed horizontally; they are marked by one large compressed tooth, followed by four or five of varying size, somewhat irregularly placed, one of which is on the posterior side of the cervical notch. The postero-lateral margins scarcely converge, there is a slight insinuation behind the cervical notch. The posterior margin is broad and marked by a sinuate ridge.

The lower orbital border is composed of two compressed tubercles, with a deep notch between the outer one and the external angle. The suborbital region is marked by 6-9 small, scattered papilliform tubercles. Two oblique, compressed, and prominent tubercles form the external angle of the buccal frame, while the front border of the buccal frame is horizontal and cut by two deep narrow notches and a small median one.

The first peduncular joint of the antennæ is large and nodular, with two distal projections, the outer one throwing out a branch behind over the base of the ocular peduncle; the next two joints are of moderate width and the flagellum is small.

The epistome is sunken, very narrow in the longitudinal direction, with a triangular process above, the apex of which projects a little and meets a process of the front.

The chelipeds are moderately robust—rather more so in the male—the carpus and propodus are scarcely compressed and are very irregularly nodular; the merus is trigonous, its upper edge bears some small, irregular tubercles, with a large nodular tubercle near the distal end; the carpus and palm are subequal in length. The fingers are broadly excavate, their outer margins provided with strong interlocking teeth. The mobile finger has a deep groove filled with hair on the outer side, the immobile one is grooved on both sides, making the lower border carinate.

The first and second pairs of legs are nearly equal in size, they are robust and nodular, the meri having strong distal tubercles on the upper margins. The meri, carpi, and propodi are subequal in length, the dactyli are strongly spined. The third and fourth pairs are a little roughened, but not nodular, the third is considerably shorter than the fourth, with very short propodi bearing each four or five distal, slightly-curved spines, two of which are opposed to each dactylus: the dactyli are strong and much curved. The fourth pair is similarly spined.

The pleon of the male has the first segment laterally produced to a point on each side, the second has the shape of a truncated triangle, the third, fourth, fifth, and sixth have the median ridge with transverse depressions, thus presenting in each case an anterior and posterior tubercle, the distal angles of each of these segments are strongly emphasized, the terminal segment is triangular. The pleon is covered with scattered papilliform tubercles.

The sternal sulci of the female reach, and are deeply cut into, a transverse prominence or tubercle, which is situated quite between the coxæ of the chelipeds.

Length of carapace, 21 mm.
Breadth „ „ 22 mm.
Length of cheliped, 28 mm.
„ „ first leg, 28 mm.

St. Vincent Gulf. Dredged by Dr. Verco. Mr. W. J. Kimber.

Types in Adelaide Museum.

Order MACRURA.

Tribe, THALASSINIDEA.

Family, CALLIANASSIDÆ.

Borradaile, Ann. and Mag. Nat. Hist. Ser. 7, vol. xii.

Genus, *Callianassa*, Leach.

Sub-genus, *Callichirus*, Stimp.

Callianassa æquimana, n. sp. Pl. xxiv., figs. 1-8.

The carapace is considerably less than one-third the length of the body, excluding the telson, mostly smooth and firm, a little punctate on the protogastric region, somewhat elevated in the median regions. The cervical groove is well marked, its posterior border reaches back a little further than the middle of the carapace. A little behind this the carapace is marked by a transverse suture, which soon sends a branch forward in a straight line to the antennal notch and another backward to the posterior margin; the transverse suture is continued on to the branchiostegite, where it ends in numerous small areolæ; from this point lines extend forwards and backwards, the forward line takes a slightly oblique and sinuous course to a point below the antennal notch; in crossing the subhepatic region it is ridge-like, below this ridge are also numerous areolæ.

The front has a very slight rostral projection, and behind it two short longitudinal grooves, more or less well marked, diverge, and are soon lost, more prominent are projections of the margin below the ocular peduncles; the antennal notch has a small lunate suture or ridge just behind it, the antero-lateral angles are rounded; in some specimens a short furrow runs obliquely on the side of the metagastric region and the upper portion of the hepatic region is somewhat uneven and punctate; the branchiostegites scarcely project behind.

The postero-lateral expansions of the pleon segments are small; the first segment is anteriorly narrowed and subcylindrical, its pleura being obsolete; the second segment, which is the longest, is produced postero-laterally to a greater degree than the three which follow. The first, third, and fifth segments are subequal in length, and the fourth shortest, the sides of the third, fourth, fifth, and sixth segments have short

transverse grooves or depressions, each of which carry a line of fine hairs, otherwise the pleon is nearly glabrous. The sixth segment tapers a little from near the anterior end, and there are two well-marked projections on the lateral margin; the posterior margin is slightly arcuate.

The telson is short, about twice as broad as long, it bears on its anterior half a sharp, transverse ridge, notched in the middle, the ends not reaching the lateral margin, the posterior margin is strongly insinuated and devoid of cilia, except one or two long ones near each posterior angle.

The ocular peduncles are much longer than broad, slightly flattened above, and distally pointed, the inner margins parallel and close together for nearly their whole length, the outer strongly curved. The eyes are small and subapical.

The antennules have the first peduncular joint scarcely reaching the end of the ocular peduncle, the second joint is nearly twice as long as the third, the flagella are equal in length and are longer than the peduncle, the lower one is setose, the upper nearly naked, except at its end.

The antennal peduncle exceeds in length that of the antennule, the first joint has the aperture of the green gland projecting, the second joint reaches to the level of the eye, the third joint is small, distinct below, but on its upper surface is a small, circular plate, which may be a rudimentary scale, the fourth joint is long, the fifth joint is about two-thirds the length of the fourth, the flagellum is long, slender, and not setose.

The external maxillipeds have the ischium and merus expanded, subequal, and together operculiform, their outer surfaces are flat for the most part, the line of articulation is curved, both are fringed with setæ on the inner margins, the ischium has a short oblique ridge near its base bearing a few hairs, the apex of the merus is thickened and obliquely truncated just behind the articulation of the carpus; the inner surface of the two joints has a longitudinal ridge about the middle, bearing on the ischium minute white teeth which are not noticeable on the merus. The next three joints are setose and together longer than the ischium and merus together; of these the carpus is the longest and is not much expanded below, but the propodus is expanded to a large lobe on that side, the terminal joint is compressed, rather broad, and distally rounded and hairy.

The chelipeds are nearly equal, the ischium is compressed with a faint longitudinal ridge on the outer surface, and one or two small teeth at the distal end of the lower margin, the merus is smooth, slightly longer than the ischium, with a faint, sigmoid ridge on the outer surface. The carpus and

propodus are deep, compressed, and strongly carinate on the upper and lower margins, externally convex and smooth, the inner side is excavate and a little tumid in the middle. The lower carina of the propodus is thickened behind, and defines a groove on the outer side. The palm is longer than the carpus, proximally slightly deeper, it tapers a little, it has a few small fascicles of hairs near the lower border, and near the upper margin is a row of pits carrying hairs, its lower margin bears a fringe of rather long hairs springing from just inside the margin—the lower anterior angle of the carpus also has a tuft of hairs—a short ridge extends from about the middle of the immobile finger backward for a short distance. The fingers are about half as long as the palm, sharp overlapping at their apices with a small hiatus when in that position, the mobile finger is without teeth and bears some fascicles of hair above and below, the immobile finger has a tooth about the middle, with a few denticles proximally from it.

The following two pairs of legs are rather short, compressed, and stout. Of these the first has the palm of the propodus very short, and the fingers, when closed, have no hiatus or teeth, the limb is setose on the margins of the joints. The carpus of the second pair is distally broad, with a tuft of long hairs on its posterior angle, and a fringe on the distal margin, the propodus is subtrianglar and compressed, its outer surface bears many hairs in fascicles, as also does the small, compressed dactylus.

The next two pairs of legs are longer and slenderer, reaching forward to the base of the maxillipeds, in the first of these the coxa is very much expanded, the propodus is compressed and thin, but not much expanded, and with the dactylus is very setose. The last pair is subchelate, the propodus and dactylus bearing an elegant brush of hairs.

The sternal aspect shows the coxæ of the first three pairs of pereiopods close together in the middle line, but the fourth pair are separated by an apparatus which is best shown by the figure, the fifth pair are wide apart.

The first two pairs of pleopods are more or less rudimentary or modified in the female—especially the second—to carry the eggs, the three following pairs are strongly developed and foliacious.

The uropods are not so large as in other species of the genus, the outer ramus is large and subtriangular, capable of folding beneath the inner ramus its inner border when in that position, extending some distance under the telson: it has a submarginal curved ridge, which extends from the outer margin about half way across the surface, this and the distal margin are thickly clothed with short hairs,

amongst which are shorter and thicker spine-like hairs. which spring from minute sockets : the distal end of the inner ramus also bears a tuft of hairs. The rami reach much further than the telson.

Length, 6 cm. 4 mm.
,, of cheliped, 3½ cm.
From Mr. D. T. Redman, Kingston.
Types in Adelaide Museum.

Tribe, CARIDEA.
Legion, POLYCARPINEA.
Family, NIKIDÆ.
Genus, *Processa*, Leach.

Processa australiensis, n. sp. Pl. xxv., figs. 2-2*e*.

The animal is moderately compressed laterally and moderately robust.

The carapace is smooth, well produced latero-posteriorly; it is about equal in length to the first three segments of the pleon. The rostrum is very short—merely a spine—slightly depressed, not reaching to half the length of the ophthalmopods, transversely broad at the base but soon tapering to an acute point, tipped with a few hairs and very obscurely bifid. The antero-lateral borders of the carapace are produced to subacute angles just below the eyes, but there are no spines, the antero-lateral angles are rounded.

The pleon has the second, third, and fourth segments dorsally subequal in length, the rest are shorter. The pleura are moderately deep, that of the first segment is well produced anteriorly, somewhat acutely, and overlapping the carapace, that of the fifth has a small tooth on its lower margin. The posterior angle of the sixth is very acute, and there is a small rounded lobe projecting over the base of the telson.

The antennule has the first joint very much compressed in the vertical direction, curved and excavate, strengthened by a strong keel below, with a transverse fringe of hairs at the upper distal end, it bears a short, broad, lamellar, and truncate stylocerite, whose outer distal angle ends in a small acute tooth, which does not reach to half the length of the joint. The second and third joints are subequal in length, and together are shorter than the first. The upper flagellum has the thickened portion slightly longer than the peduncle, it terminates in a short, slender portion. The lower flagellum is slender and about twice as long as the upper.

The ophthalmopods are large, pyriform, being very slen-

der at the proximal ends, touching each other in advance of the rostrum.

The antenna has a long, narrow scale, truncate at the end, the sides are nearly parallel, reaching a little beyond the antennular peduncle, the external rigid border ends in a small distal spine which scarcely extends beyond the lamellar portion, the fringe is very long. The peduncle reaches about three-fourths the length of the scale. The flagellum is longer than the animal.

The third maxillipeds are very robust, extending forward beyond the upper flagellum of the antennule; of the three joints the first is flattened on the inner side, and its proximal end is narrowed, it is much longer than the two succeeding joints taken together, the second and third joints are subequal in length, slightly setose; the third, which is directed outwards, quickly tapers to a strong, slightly-curved terminal tooth, the inner side bears some strong spines, as also does the distal end of the second joint on the same side. The exopod is small.

The first pair of legs has the chelate one on the right side, it is short and robust; the merus is nearly as long as the carpus and propodus together, the propodus tapers somewhat from the proximal end, the fingers are shorter than the palm, curved, and end in simple sharp claws, which cross each other. In the opposite limb, which is slightly setose, the propodus tapers considerably to a simple, narrow, curved, and sharp dactylus.

The second legs are slender and nearly equal to each other: that on the left has the ischium compressed, long, and apparently divided about the middle, with a slight expansion near the proximal end, tipped with a few recurved setæ. The merus has 5-7 obscure annuli, it is subequal in length with the ischium. The carpus is about one and a half times as long as the merus, multi-jointed, the joints short and nearly equal in length, except the last, and expanding slightly towards the distal end; the propodus is short, the palm being about as long as the last carpal joint, the fingers are about as long as the palm.

The ambulatory legs are long and moderately robust, the carpal joints are as long and sometimes longer than the meri, and longer than the propodi, except, perhaps, in the last pair, the propodi are slightly compressed and furnished with minute hairs behind, the dactyli are short and only slightly curved, simple, and bear two fascicles of minute hairs near the ends. Of these legs the first pair have two spines on the outer side of the ischium and three on the merus. The second has one spine on the ischium and

three on the merus, the last of these being near the distal end; these spines are short and are difficult to see, being so closely pressed to the joint as to have almost the nature of scales.

The uropods are longer than the telson, the peduncle is very short, its outer lobe is rounded, the rami are moderately broad, the external margin of the outer one nearly straight, ending in a well-marked tooth with two spines close to it. The division is curved.

The telson is rather narrow, tapering to end in four spines—besides the small teeth at the angles—two each side, the inner ones longer; medianly there are two well-developed plumose setæ. The quadrately-placed spines of the dorsal surface project considerably.

The ova are small and numerous.

Length, omitting rostrum and telson, 16 mm.

,, of carapace, 6 mm.

,, ,, third maxilliped, 9 mm.

South Australian coast.

Types in Adelaide Museum.

Processa gracilis, n. sp. Pl. xxv., figs. 3-3*c*.

The body is slender, the carapace is about as long as the first four segments of the pleon, slightly depressed. The rostrum is short and slender, almost to the base, bears a few hairs at the tip, and projects more than half the distance of the ophthalmopods. The antero-lateral margin bears a small tooth below the eye peduncle, followed by a faint insinuation behind the antennal peduncle, below this the lateral margin quickly slopes backwards.

The segments of the pleon do not differ much in dorsal length, and the pleura are not deep; that of the fifth segment is without a tooth near the posterior angle.

The ophthalmopods are robust, pyriform, but swollen at their bases on the inner sides, then abruptly becoming very narrow at the joint. The eyes are well developed, and do not touch anteriorly.

The antennular peduncle is robust, the first joint vertically compressed and hollowed in the usual manner, the stylocerite is spiniform and well separated from the body of the joint, reaching about three-fourths its length, the second and third joints are subequal in length, the upper flagellum is robust, rather longer than the peduncle, and clothed with dense cilia; the lower flagellum is very slender, and more than twice as long as the upper.

The antennal scale is long, rather narrow, rigid on the external margin, the distal spine scarcely projecting farther

than the lamellar portion which is distally truncated, it projects beyond the antennular peduncle. The peduncle reaches more than half the length of the scale, the flagellum is slender and long.

The third maxillipeds are similar to those of the preceding species, reaching forward nearly as far as the upper flagellum of the antennule.

The first pair of legs are strong, with the chelate limb on the right side, in this the merus is longer than the carpus and propodus together, the carpus is short, the palm a little longer than the carpus, the fingers are shorter than the palm, they are acute and simple. On the opposite limb the propodus tapers much, and is slightly longer than that of the right side, and slightly setose, the dactylus is short, sharp, and curved.

The second legs are very slender, the ischium joints are considerably more expanded than in the preceding species, that of the right side has the ischium and merus subequal in length, the carpus being as long as these two together, very mobile, and composed of about 40 articuli, which do not expand towards the distal end: the limb ends in very minute chelæ. The limb of the left side is shorter and has the carpal joint with about 20 articuli, which become gradually more expanded distally, the propodus and chelæ being well developed. In these limbs the meri have very obscure annulations.

The three pairs of ambulatory legs are long and slender, with—except in the last pair—the carpi slightly longer than the propodi, the propodi have on their anterior margins a close row of very minute and regular hairs, the posterior margins are setose in scattered fascicles. The dactyli are short, simple, and have one or two small fascicles of hairs near the terminal claw, which is minute. The ischii and meri of the two first pairs of these legs are obscurely spined, as in the preceding species.

The pleopods are robust.

The telson is narrow, long, tapering to a narrow end, and on its dorsal surface minutely and sparingly pubescent, the quadrately placed spines are obsolete or nearly so—the terminal spines are broken off in this specimen.

The uropods are about as long as the telson, the outer ramus has its external margin straight, terminating in two small spines; the division, which is well marked, is somewhat arched.

Length of body, excluding rostrum and telson, 18 mm.

„ „ carapace, 6 mm.

South Australian coast.

One male; type in Adelaide Museum.

Legion, Monocarpinea.
Family, Pontoniidæ.
Borradaile, Ann. and Mag. Nat. Hist. Ser. 7, vol. ii., p. 376.
Genus *Pontonia*, Latreille.

Pontonia minuta, n. sp. Pl. xxiv., figs. 9-12.

The body is short, moderately robust, the pleon rather more bulky than the thorax in the female.

The carapace is about as long as the first four segments of the pleon, much broader than deep, with a triangular, subacute, infra-ocular tooth, and with the antero-lateral angles projecting a little beyond the base of the antennal scale, and also subacute. The postero-lateral lobe overlaps the first segment of the pleon. The rostrum is short, entire, depressed broad dorsally, rather obtuse at the apex, with a faint, broad median ridge, which scarcely extends on to the carapace, and is slightly pinched between the eyes, it has lateral sinuate ridges continuous with the orbits behind, and is rather deeply carinate below, even at the distal end, it reaches rather more than twice the length of the ophthalmopods.

The pleon is smooth and considerably narrowed behind in both directions, the terga of the second, third, and fourth segments are subequal in length, the first and fifth shorter, the sixth very short and narrow, with rather obtuse postero-lateral angles.

The telson is rather broad and regularly tapering, rounded distally, and scarcely fringed at the end, about two and a half times as long as the sixth segment of the pleon, with a broad, longitudinal sulcation, reaching quite to the end, it bears the usual quadrately placed spines, which are rather low down, and near the margin and scarcely project.

The ophthalmopods are short, without ocelli.

The antennular peduncle is a little longer than the rostrum, it is strong, the first joint is hollowed a little above, and has a very small stylocerite, the second joint is conspicuous, but the third is very small; the upper flagellum is about as long as the peduncle, and is folded back above, it is thick proximally, but soon tapers to a distal slender portion on the thickened portion, the sensory filaments are long and numerous, it is one-branched—or the splitting is very obscure; the lower flagellum is very short, and projects normally.

The antennal scale is rather ovate, it reaches as far as the antennular peduncle, the external distal spine is strong, terminating a thickened outer margin, it is subterminal in relation to the lamellar portion, the peduncle reaches as far as the scale; the flagellum is short and curves backwards.

The third maxillipeds are suboperculiform, of the three joints of the endopod the first is stout and compressed or ex-

panded, especially at the base, the next two joints are small, and both together shorter than the first. The exopod is very small.

The first pair of legs are slender and chelate, the merus a little curved and subequal in length to the carpus, the carpus expands a little distally, the propodus is much shorter than the carpus and bent at an obtuse angle from it, it is a little compressed and expanded, and bears a brush of stiff setæ at the base of the immobile finger, the fingers are subequal in length to the palm, are slender, and do not gape.

The second legs are moderately robust, symmetrical, and equal, the ischium and merus combined are considerably shorter than the carpus and propodus combined, these together are a little compressed laterally and somewhat spindle-shaped in outline; the carpus is a little excavated on its outer surface, the propodus is more than twice as long as the carpus, the fingers are equal, rather narrow, curved, slightly setose, ending in acute points, and have a wide gape, they are about half the length of the palm.

The next two pairs are missing in this specimen. The last pair is more robust than the first, the propodus is strongly compressed, and its anterior margin is a little curved, its posterior margin nearly straight, it has a small distal spine with a longer one just above it, and a few hairs; the dactylus is strong, simple—or perhaps a little bifid at the tip—slightly curved, and is without a basal thickening.

In the first pleopods the inner ramus is small, the remaining pairs have the inner rami provided with long processes—*Stylamblys*.

The uropods are about as long as the telson, ovate, the subterminal spine of the outer one is very minute, and there is a very faintly-marked division.

There are five well-developed branchial plumes on each side.

The eggs are large and few.

Length, 11 mm.

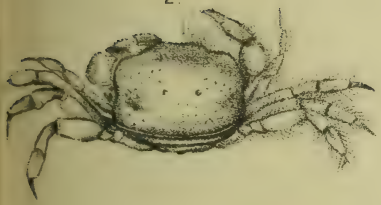
Dredged by Dr. Verco; host unknown.

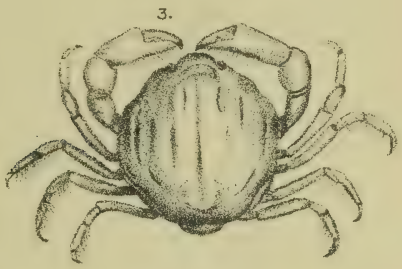
Type, one in Adelaide Museum.

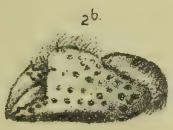
DESCRIPTION OF PLATES.

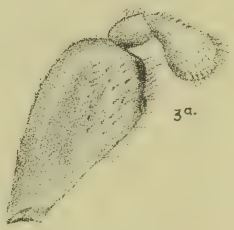
Plate XXIII.

Fig. 1. *Cycloxanthus* (?) *carinatus*, n. sp., enlarged.
,, 2. *Ceratoplax punctata*, n. sp., nat. size.
,, 2*a*. ,, ,, pleon of female, enlarged.
,, 2*b*. ,, ,, cheliped, enlarged.
,, 3. *Pinnoteres holothuriensis*, n. sp., enlarged.
,, 3*a*. ,, ,, external maxilliped, enlarged.
,, 4. *Dromia octodentata*, Haswell, nat. size.









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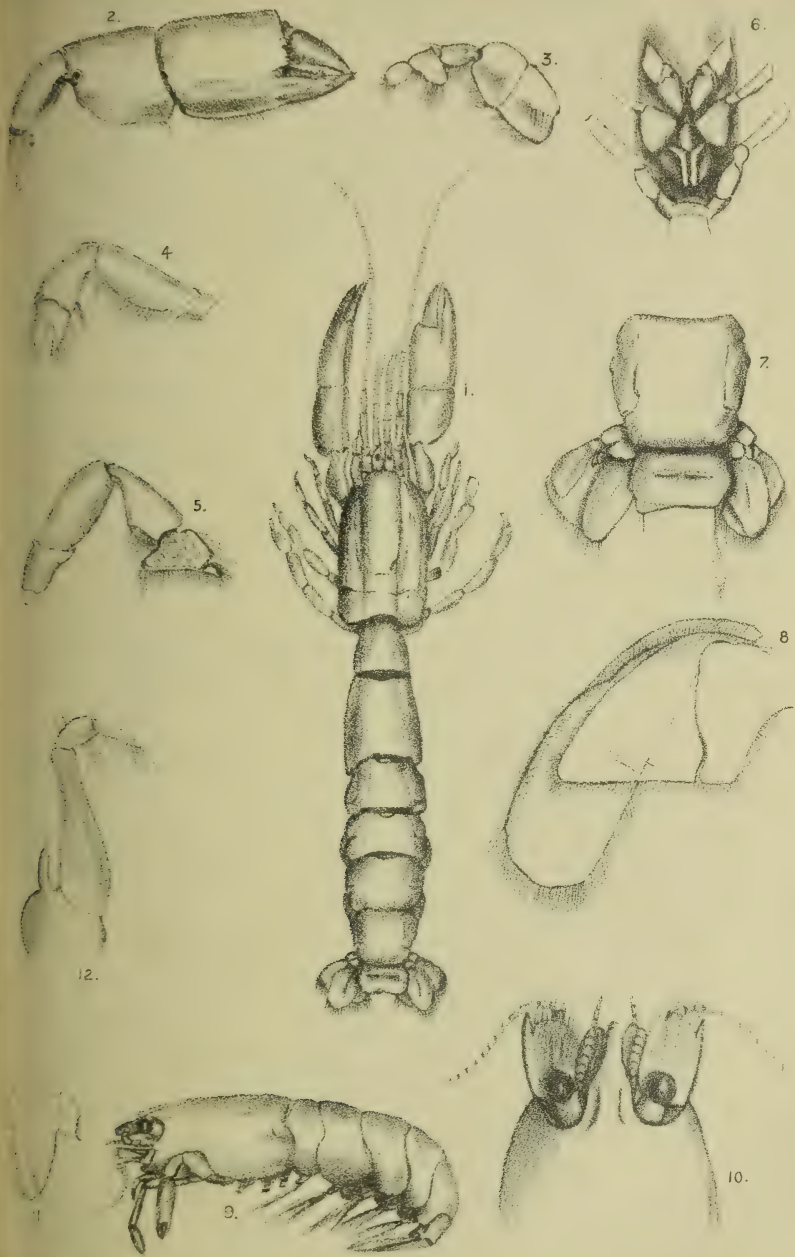
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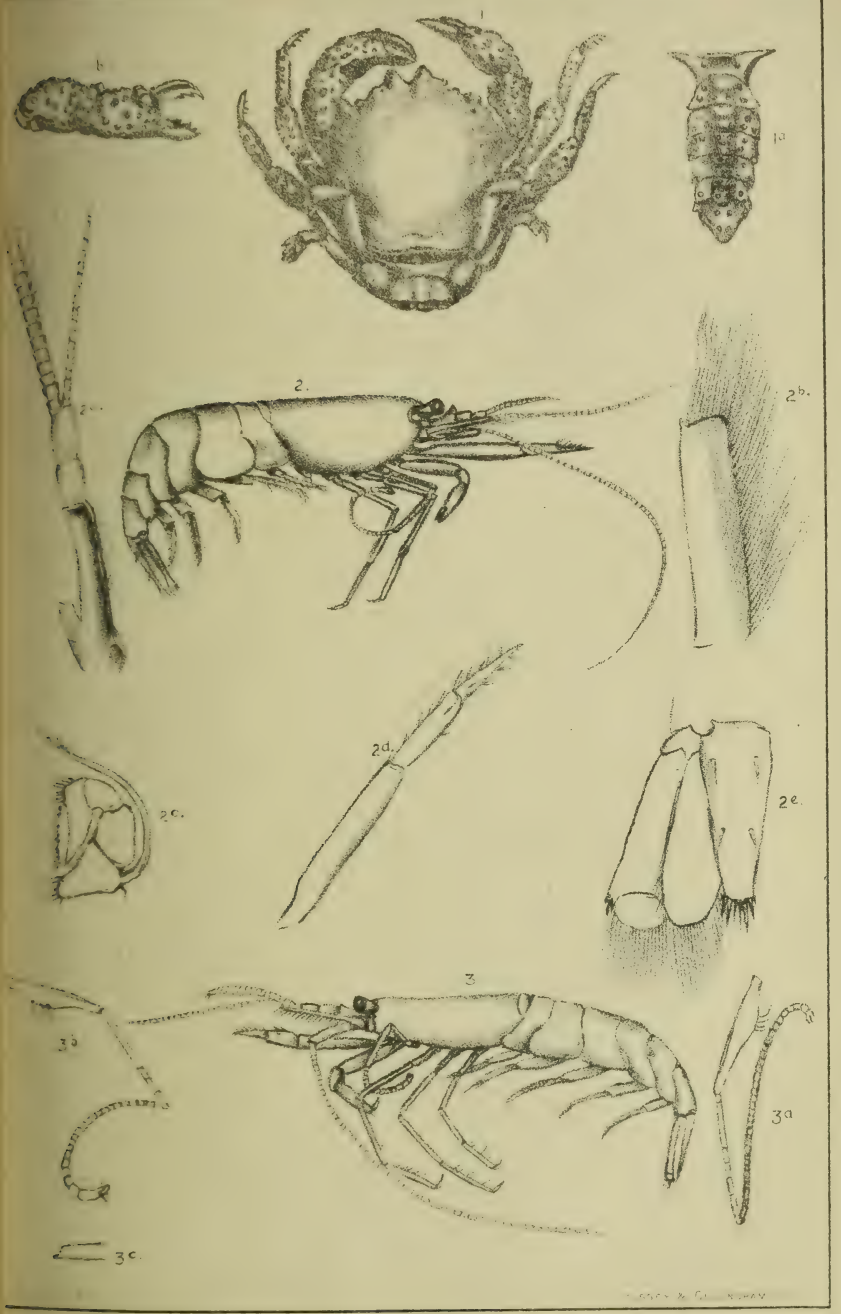

1
1a
1b
2.
2a.
2b.
2c.
2d.
2e.
3
3a
3b
3c.

Plate XXIV.

Fig. 1. *Callianassa æquimana*, n. sp., nat. size.
,, 2. ,, ,, cheliped, enlarged.
,, 3. ,, ,, maxilliped, enlarged.
,, 4. ,, ,, 1st pereiopod, enlarged.
,, 5. ,, ,, 2nd ,, ,,
,, 6. ,, ,, portion of sternum, enlarged.
,, 7. ,, ,, 6th segment of pleon and tail-fan, enlarged.
,, 8. ,, ,, pleopod of 3rd segment of pleon, enlarged.
,, 9. *Pontonia minuta*, n. sp., enlarged.
,, 10. ,, ,, anterior portion, enlarged.
,, 11. ,, ,, end of 2nd maxilliped, enlarged.
,, 12. ,, ,, 3rd maxilliped, enlarged.

Plate XXV.

Fig. 1. *Cryptodromia depressa*, n. sp., nat. size.
,, 1*a*. ,, ,, pleon of male, enlarged.
,, 1*b*. ,, ,, cheliped, ,,
,, 2. *Processa australiensis*, n. sp., enlarged.
,, 2*a*. ,, ,, antennule, ,,
,, 2*b*. ,, ,, scale of antenna, enlarged.
,, 2*c*. ,, ,, 2nd maxilliped, ,,
,, 2*d*. ,, ,, 3rd ,, ,,
,, 2*e*. ,, ,, uropods and telson, ,,
,, 3. ,, *gracilis*, n. sp., enlarged.
,, 3*a*. ,, ,, 2nd pereiopod, right side, enlarged.
,, 3*b*. ,, ,, 2nd pereiopod, left side, ,,
,, 3*c*. ,, ,, tip of rostrum, ,,

Revision of the Australian Psychidæ.

By Edward Meyrick, B.A., F.Z.S., etc., and Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read August 6, 1907.]

The members of this family are extraordinary insects, and comprise the most curious and remarkable of all Australian Lepidoptera; their larval habitations exemplify insect architecture in its most remarkable forms.

Some of the smaller *Tineina*, such as *Xysmatodoma* and *Talæporia*, exhibit similar larval peculiarities, but their cases (cocoons) never assume the proportions or ornamentation of the *Psychidæ*, although one species, *i.e.*, *Talæporia magnella*, Walk., deserves more than passing notice on account of its peculiar cylindrical case, which is built in the form of tiers.

The ♀ of the *Psychidæ* are usually thick, rather short, fleshy, grub-like creatures, devoid of wings, legs, or any properly developed antennæ. According to McCoy (Prod. Zool., Vic., iv. [1879), "the ♀ never leaves the case (cocoon), but after copulation brings forth an abundance of eggs, and the newly-hatched larvæ lower themselves by a fine strong silken thread, and immediately commence to each form a portable habitation for themselves, consisting of small pieces of leaves, bark, etc. These larval cases are open at the ends, and the larvæ protrude themselves just sufficiently out of the anterior portion of the case to use their legs for locomotion, generally fixing part of the edge of the aperture by fibres of silk, temporarily, to the twig it is on, so that when alarmed it withdraws completely within the larval case, which remains suspended and quite closed."

The cases are common and rather conspicuous objects in our scrubs, but the perfect insects are seldom met with, as the larvæ are subject to attacks of various species of parasitic *Diptera* and *Ichneumonidæ*.

The family is of cosmopolitan distribution, but more numerous in warm climates. The ♂ imago has thinly-scaled wings, without markings; flight strong and swift. The ♀ is almost wholly helpless; the abdomen is at first greatly distended with eggs, but ultimately shrivels up.

PSYCHIDÆ.

Head, densely rough-haired. Ocelli large. Tongue obsolete. Antennæ $\frac{1}{2}$, in ♂ strongly bipectinated to apex, sometimes apical portion simple. Labial palpi very short.

Thorax densely hairy above and beneath. Abdomen, femora, and tibiæ densely hairy, posterior tibiæ without middle spurs, end spurs very short. Forewings: 1a anastomosing with 1b before middle, 1c (when present) coincident with 1b beyond middle. Hindwings: 8 with one or more costal pseudoneuria (rarely without), 5 and 6 sometimes absent. ♀ apterous, without legs or developed antennæ.

Genera of Psychidæ.

In all the Australian genera the anterior tibiæ have a long strong spine rising from near base beneath in forewings. 1a coincides with 1b before middle.

TABULATION.

1. Antennæ bipectinated to apex 2
,, with apical portion simple .... *Oiketicus*
2. Basal joint of anterior tarsi much elongated --- *Plutorectis*
,, ,, ,, normal 3
3. Terminal joint of anterior tarsi much elongated ... *Clania*
,, ,, ,, normal 4
4. Forewings with vein 9 absent ... ... *Elinostola*
,, ,, ,, present 5
5. Hindwings with vein 5 absent ... ... *Hyalarcta*
,, ,, ,, present ... ... *Paracharactis*

1. ELINOSTOLA, n. g.

Antennæ bipectinated to apex (?) Abdomen moderate. Forewings with 1c coincident with 1b beyond middle, 4 and 5 stalked, 7 and 8 stalked, 9 absent. Hindwings with vein 5 absent, 6 absent, 8 without pseudoneuria.

Type.—*Hypomela.*

Recognized amongst other characters by the absence of vein 9 of forewings.

1. E. HYPOMELA, n. sp.

♂, 15 mm. Head, thorax, legs, and abdomen blackish (antennæ imperfect). Forewings rather elongate, moderately dilated posteriorly; costa somewhat rounded, termen oblique; very pale fuscous, semi-hyaline; cilia fuscous. Hindwings rather small, termen oblique, apex slightly prominent, dark fuscous, becoming paler on basal half; cilia as in forewings.

Case, unknown.

Brisbane, Queensland. One specimen; in September.

2. HYALARCTA, n. g.

Antennæ bipectinated to apex. Abdomen moderate. Forewings with 1c coincident with 1b beyond middle, 5 absent, 6 from above middle of transverse vein, 7 sometimes out of 8, 8 and 9 stalked, 10 and 11 sometimes stalked. Hindwings

with vein 5 absent, 6 and 7 approximated or coincident, 8 coincident with cell beyond middle.

Type, *nigrescens*, Dbld.

Differs from the other Australian genera by the absence of vein 5 of forewings.

1. Antennæ blackish ... ... 2 *nigrescens*
2. ,, dark orange ... ... 3 *Huebneri*
3. Antennal pectinations 10 ... ... 4 *ptiloclada*
4. ,, ,, 6 1

2. H. NIGRESCENS, Dbld.

Thyridopteryx nigrescens, Dbld., Eyre Exped. Aus. i., p. 437, t. 5, fig. i., 1845. *Oiketicus Herrichii*, Westw., P.Z.S., p. 232, t. 37, fig. 3, 1854; Macal. Proc. N.H. Soc., Dublin v., p. 132, fig. i., 1867.

♂, 26 mm. Head, thorax, and abdomen black: face and palpi white; thorax sometimes with a posterior dull ochreous spot. Antennæ dark fuscous, pectinations fuscous, at greatest length 6. Legs ochreous-reddish, hairs of tibiæ black. Forewings elongate-triangular, costa straight, apex rounded, termen rounded oblique; hyaline-iridescent, veins outlined with ochreous-reddish; a broad ochreous-reddish costal streak, from base of costa to end of cell, caused by thickening of veins; base of wing blackish, especially along dorsum; cilia ochreous-fuscous. Hindwings rather small, apex rounded, tolerably prominent, termen rounded, continuous with apex; colour, veins, and cilia as in forewings: dorsal third of wing thickly irrorated with minute scales, forming a patch throughout.

Case.—30-38 mm. in length, 30 mm. in circumference at greatest breadth; greyish-ochreous, minutely spotted with blackish; cylindrical, moderately smooth, not ornamented with leaves or twigs, tapering at both ends, lower end more elongate and narrow. Surface marked with seven longitudinal ridges, by their projections forming concavities between the ridges, which gives a transverse section the appearance of a heptagon with concave sides. The case is fixed by its upper end to the food-plant by a strong, short, thick appendage, which is sometimes looped around the twig to which it is attached.

The case is not unlike a large dried seed capsule in general appearance.

Larva.—The larvæ are fuscous, mixed with blackish, the head and anterior segments becoming pale fuscous, and the second thoracic segment is irrorated with fuscous. Feeds on *Eucalyptus*, sp.

This is not a common species.

Sydney, New South Wales; Adelaide, South Australia; and Gisborne, Victoria. Five specimens; in February and March.

3. H. HUEBNERI, Westw.

Oiketicus Huebnerii, Westw., P.Z.S., p. 228, t. 36, fig. i., 1854; Macal. Proc. N.H. Soc., Dublin, p. 133. *O. Careyi*, *ib.*, *l.c.*, p. 133.

♂, 28 mm. Head, face, thorax, and abdomen blackish-fuscous, antennæ dark-orange, pectinations dark-orange, at greatest length 6. Legs dark-fuscous. Forewings elongate-triangular, costa straight, apex rounded, termen obliquely rounded; hyaline-opalescent; veins outlined with pale ochreous, costa broadly pale yellow, from base to near $\frac{3}{4}$, caused by confluence of veins; cilia ochreous. Hindwings rather small, termen rounded; colour, veins, and cilia as in forewings; costa with a broad black line from base to middle, hairs of dorsum black, moderately thick.

Case.—40-45 mm. in length; diameter, 13 to 15 mm.; circumference, 30 mm.; extreme circumference, 54 mm.; ovate-lanceolate, broadly tapering at both ends; dull grey-whitish or greyish-fuscous, thickly ornamented except posterior $\frac{1}{6}$ with (A) innumerable, irregularly arranged fine long twigs of *Pinus insignis*, which hang down loosely and vary in length from 10 to 40 mm. (B.) ornamented with similar twigs and pieces of leaves or phyllodia of *Eucalyptus*. (C) ornamented throughout with moderately large pieces of leaves or phyllodia of *Eucalyptus* and *Leptospermum*, placed indiscriminately. The opening of the lower extremity of the cocoon is broadly ovate. The case is fixed to the food-plant by a thick piece of strong, silken material which is generally looped to the stem, but is sometimes without the loop. The cases are very different in their outward appearance on account of the different food-plants.

Larva.—The larvæ are similar to the previous species, but somewhat lighter-coloured, and marked with reddish on anal segments.

This species is easily separated from *nigrescens*, Dbld., by its orange antennæ.

Adelaide, South Australia; Melbourne, etc., Victoria; Sydney, etc., New South Wales; and Brisbane, Queensland. Several specimens; from December to April.

4. H. PTILOCLADA, n. sp.

♂, 28 mm. Head grey-whitish. Thorax and abdomen black, thorax anteriorly with a patch of whitish hairs. Abdomen rather elongate. Antennæ fuscous, pectinations fuscous, at greatest length 10 (imperfect). Legs blackish. Forewings very elongate, costa slightly arched, apex rounded, termen strongly oblique, gently rounded; hyaline, slightly iridescent; veins outlined with pale ochreous; a broad pale ochreous costal streak caused by confluence of veins, from base to $\frac{3}{4}$; basal

fourth of wing thickly irrorated with fuscous scales; cilia fuscous. Hindwings rather small; colour, cilia, and veins as in forewings, basal portion of wing as in forewing, but the colour is continued further along dorsum.

Case and *Larva*.—Unknown.

Differs from the other species by the more elongate forewings and longer pectinations of antennæ.

Nar-nar-goon, Victoria. Type in *Coll., Lyell.*

3. Clania, Walk.

Antennæ bipectinated to apex. Terminal joint of anterior tarsi elongate. Abdomen moderate. Forewings with several dorsal pseudoneuria, 1c coincides with 1b beyond middle, 4 and 5 stalked, 7 connate with 8, 8 and 9 stalked. Hindwings with 4 and 5 stalked, 8 connected or anastomosing with 7, with several costal pseudoneuria. Recognized by the anastomosis of veins 8 and 7 of hindwings. The cases of the species vary little in appearance.

1.	Face white, antennæ ochreous-fuscous	5	*Dewitzi*
2.	,, ,, dark fuscous ...	6	*ignobilis*
3.	Thorax with longitudinal white stripes	7	*tenuis*
4.	,, without ,, ,,	6	
5.	Forewings light fuscous, semi-transparent	8	*Lewinii*
6.	,, blackish fuscous, opaque ...	5	
7.	,, hyaline, devoid of markings ...	9	*hemitricha*
8.	,, ,, with black scales on margins	10	*photidias*

5. C. Dewitzi, Heyl.

Oiketicus Dewitzi, Heyl., Ann. Soc. Ent. Belg., xxix., p. cxix., 1886.

♂, 32 mm. Head, thorax, and abdomen fuscous, face whitish, thorax mixed with rufous and dull whitish. Antennæ ochreous-fuscous, pectinations reddish-ochreous, at greatest length 6. Legs fuscous, anterior pair mixed with reddish-ochreous, and with a whitish tuft of hair on anterior portion of tibiæ. Forewings elongate, moderately broad, costa gently arched beyond middle, termen unevenly rounded, oblique; dark fuscous, inclining to black on basal third; veins outlined with fuscous; semi-transparent; cilia dark fuscous. Hindwings with apex rounded, termen rounded continuous with apex; colour and cilia as in forewings, hairs of dorsum dark fuscous.

Differs from the other species by its blackish colouring and ochreous antennæ.

Case and *Larvæ*.—Unknown.

Launceston, Tasmania. One specimen; in October. The type came from Sydney, New South Wales.

6. C. IGNOBILIS, Walk.

Entometa ignobilis, Walk., Char. Lep. Het., p. 67, n. 7, 1869; McCoy, Proc. Zool. Vict., iv., t. 40, ff. 7-10, 1879.

♂, 36-40 mm. Head and thorax ochreous-reddish, face white or whitish, thorax anteriorly paler. Antennæ and abdomen dull ochreous-reddish, somewhat fuscous tinged, a dull whitish tuft of hair at base of antennæ. Antennal pectinations at greatest length, 8. Legs pale ochreous-fuscous. Forewings elongate, costa almost straight, arched towards apex, apex hardly rounded, termen oblique; fuscous, becoming darker around edges and towards base, cell semi-transparent; veins outlined with ochreous fuscous; cilia fuscous. Hindwings with apex somewhat prominent, termen oblique. Slightly sinuate, on posterior half; colour, outlining of veins, and cilia as in forewings.

Case.—35-50 mm. in length; diameter, 10-15 mm.; circumference, 30-45 mm. Cylindrical, tapering broadly at both ends; dull fuscous, thickly ornamented with a solid fence of stout pieces of stems of food-plant, placed longitudinally and placed thickly together. These pieces of stems vary in length from 20 to 90 mm. Of the latter lengths there are but 2 or 3 to each case, and are usually much thicker than the others, appearing to act as supports.

Larvæ.—The larva is a somewhat fusiform, short, almost naked, fuscous-coloured creature. Head and thorax creamy white, thickly strigulated with dark fuscous, posterior segments with a few scattered hairs.

This is the commonest and most widely distributed species of the group. The larvæ feed on various species of *Eucalyptus*. (We have bred the ♂ from *E. rostrata* in South Australia.) But the perfect insects are rarely taken on the wing, being unmercifully attacked by various species of parasitic *Diptera* and *Ichneumonidæ*, in the larval stage. It has stood for many years in collections as *Entometa ignobilis*, but the genus *Entometa* is one of the *Lasiocampidæ*, of which *obliqua*, Walk., is the type, according to Kirby.

The type of *ignobilis* is in the National Museum, Melbourne.

Sydney, New South Wales; Melbourne, Gisborne, etc., Victoria; Perth, Western Australia; and Adelaide, etc., South Australia. Several specimens; in January and February.

7. C. TENUIS, Rosen.

Ann. Nat. Hist., 5, xvi., p. 422, t. 11, fig. 3, 1885.

♂, 22 mm. Head, thorax, antennæ, abdomen, and legs black, face snow-white, patagia white, thorax with two raised

woolly-white longitudinal stripes of hair almost meeting at posterior portion, and more or less continued to anterior portion of abdomen, antennal pectinations at greatest length 6. Forewings elongate, moderate, costa nearly straight, apex rounded, termen gently bowed, oblique; light fuscous, minutely irrorated with blackish, more especially around margins; cell with an almost transparent elongate cordate patch at posterior extremity; veins outlined with blackish; cilia short, blackish. Hindwings with apex rounded, termen rounded, continuous with apex; colour, veins, and cilia as in forewings; hairs of dorsum blackish.

Case.—25-28 mm. in length; dull greyish-fuscous. main projecting twin 35 mm. long, case 7 mm. in diameter, 27 mm. in circumference, ornamented by about four main pieces of twigs of *Eucalyptus*, sp., which are the full length of cocoon, and about 12 to 16 smaller, shorter, and somewhat similar pieces, some of which are equally as long as the four, but thinner; the main projecting stem is generally much thicker than the rest, and extends about 10 mm. beyond the extremity of the lower aperture of case. Outer portion of twigs more or less covered with innumerable silky grey-whitish hairs, rather short.

Launceston, Tasmania. A fine series bred by Mr. F. M. Littler; in January. Also from Sydney, New South Wales; Blackwood and Port Lincoln, South Australia; Gisborne and Stawell, Victoria.

8. C. Lewinii, Westw.

Oiketicus Lewinii, Westw., P.Z.S., Lond., 1854. p. 231. t. 37, fig. 1; Macal., Proc. Nat. Hist. Soc., Dublin, v., p. 131, 1867.

♂, 24 mm. Head, thorax, antennæ, abdomen, and legs brownish, face whitish, patagia whitish, thorax with two dull white longitudinal stripes of woolly hair more or less meeting posteriorly. Antennal pectinations light fuscous, pectinations at greatest length 6. Forewings elongate, moderate, costa nearly straight, apex rounded, termen gently bowed, oblique; very light fuscous, minutely irrorated with darker fuscous, especially around margins; cell with an almost transparent elongate-cordate mark at posterior extremity; veins outlined in dull fuscous; cilia fuscous, rather short. Hindwings with apex rounded, termen rounded continuous with apex; colour, veins, and cilia as in forewings, hairs of dorsum light fuscous.

Case.—Unknown.

This species appears to differ from the preceding, to which it is closely allied, by its larger size and more brownish colouring; *tenuis* approaches it very closely in general appearance, but the colouring in the 16 specimens before me of that species

is black or blackish, whereas in the present it is brown or pale brown.

Gippsland, Victoria; Sydney (Katoomba), New South Wales; Blackwood, South Australia. Five specimens; December to February.

9. C. HEMITRICHA, n. sp.

♂, 25 mm. Head and thorax fuscous, face whitish, thorax with whitish longitudinal lateral stripes. Antennæ fuscous, pectinations at greatest length 8. Abdomen fuscous. Legs fuscous, anterior coxæ very hairy. Forewings elongate, moderate; costa hardly arched, termen gently bowed oblique; hyaline, semi-transparent; faintly iridescent; basal half of wing irregularly and minutely irrorated with light fuscous; costal area narrowly fuscous; veins outlined with light fuscous; cilia fuscous, short. Hindwings with termen rounded, faintly sinuate in middle; an irregular patch of fuscous scales towards base, dorsal hairs fuscous; veins and cilia as in forewings.

Case.—Unknown.

Differs from the other described species by the longer antennal pectinations and clearer wings.

Townsville, Queensland. One specimen bred in October *(Dodd)*. I also possess two damaged specimens from Cooktown. Sent by Mr. Olive.

10. C. PHOTIDIAS, n. sp.

♂, 40 mm. Head, thorax, and abdomen ochreous-fuscous, face mixed with whitish. Antennæ fuscous, pectinations dark-fuscous, at greatest length 12. Legs ochreous-fuscous. Forewings elongate, moderately dilated. Costa nearly straight, apex rounded, termen oblique; semi-transparent, somewhat irridescent, with some minute sparse scales around margins, thickest near base of costa; veins outlined with light fuscous; cilia fuscous (imperfect). Hindwings with apex rounded, continuous with termen; colour, veins, and cilia as in forewings; hairs of dorsum ochreous, mixed with fuscous.

Case.—Unknown.

At once recognized by the clear wings and long pectinations of antennæ.

Cairns, Queensland. One specimen taken by the late G. Barnard at Barron Falls.

4. OIKETICUS, Guild.

Antennæ bipectinated, towards apex simple. Basal joint of anterior tarsi very elongate. Abdomen extremely elongate. Forewings sometimes with several dorsal pseudoneuria,

1c coincides with 1b beyond middle, 4 and 5 stalked, 7 and 8 out of 9. Hindwings with 4 and 5 stalked, with a coastal pseudoneurium before middle.

Thorax, orange	...	...	...	...	11. *elongatus*
,, fuscous	...	...	...	...	12. *tertius*

11. O. ELONGATUS, Saund.

Trans. Ent. Soc. Lond. v., p. 43 (1847). *Metura elongata*, McCoy, Prod. Zool. Vict. iv., p. 43, t. 40, ff. 1-6 (1879). *O. Saundersii*, Westw., P.Z.S., Lond., p. 223, t. 35 (1854).

♂, 42-48 mm. Head and thorax orange-yellow, thorax posteriorly blackish. Antennæ black, pectinations black, at greatest length 8, very short on anterior half. Abdomen very elongate, orange, with broad, black posterior segmental bands, two anterior segments wholly black. Legs blackish, anterior tibiæ dull orange, banded with blackish above. Forewings very elongate, rather narrow, slightly dilated posteriorly, costa slightly arched beyond middle, apex strongly rounded, termen rounded, continuous with apex, slightly sinuate before anal angle; dark fuscous, becoming blackish along basal and costal areas; veins outlined with dull ochreous-white, semi-transparent on some portions; cilia fuscous. Hindwings with costa strongly arched, apex prominent, termen rather strongly sinuate at anal angle; colour, markings, and cilia as in forewings; dorsal hairs rather long, blackish.

Case.—80-120 mm. in length, extreme diameter 40-60 mm. Cylindrical tapering at both ends; greyish-white mixed with fuscous, lower portion more or less covered with small pieces of broken phyllodia, etc., and indiscriminately ornamented on upper half with stout twigs of *Eucalyptus*, varying from 20 to 30 mm. in length in irregularly-arranged series; those on lower half are generally much longer, and vary from 30 to 70 mm., usually from 3 to 6 of latter length. Case usually fixed to food-plant by a piece of strong silken appendage from 10 to 15 mm. long, and about 5 mm. in diameter. Easily recognized by the rather narrow, elongate forewings and orange and black abdomen.

Melbourne, etc., Victoria; Sydney, etc., New South Wales. Four specimens in December. We have not yet met with specimens from South Australia, although the species is said to be taken there.

12. O. TERTIUS, Temp.

T.E.S., Lond., v., p. 39, t. 5, ff. 1-5 (1847); *O. Templetonii*, Westw., P.Z.S., Lond., p. 234, t. 36, fig. 2 (1854). *Eumeta T.* Walk. Cat. Lep. Het. iv., p. 965 (1855). *Dappula T.*, Moore, Lep. Ceylon ii., p. 103 (1883). *Oiketicus ulias*, Low, Proc. Linn. Soc., N.S.W., p. 83 (1899).

♂, 40 mm. Head, thorax, antennæ, and abdomen dark fuscous, face ochreous-fuscous, antennal pectinations at greatest length 8. Legs, dark fuscous; tarsi, with dull whitish rings. Forewings rather elongate. Costa slightly arched on apical half, termen very oblique, slightly bowed; dark fuscous; an elongate, somewhat ovate, very dark fuscous spot, occupying posterior half of cell, edged posteriorly, and sometimes laterally, with a narrow strip of dull whitish, which tends to be continued along veins posteriorly; lower portion of base of wing somewhat darker than rest of ground colour; cilia very short; fuscous. Hindwings, with apex prominent, hardly acute, termen sinuate in middle; dark fuscous; cell more or less outlined with dull whitish; dorsal hairs dull ochreous-fuscous; cilia as in forewings.

Case and *Larva*.—Unknown.

At once recognized by its uniform colouring and elongate-ovate spot in cell.

Cooktown, Queensland. Several specimens received from Messrs. E. A. Olive and F. P. Dodd in August and November; also from India and Ceylon.

5. Plutorectis, n. g.

Antennæ bipectinated to apex. Basal joint of anterior tarsi much elongated. Abdomen moderately elongate. Forewings with one or more dorsal pseudoneuria; 1c coincides with 1b beyond middle; 4 and 5 connate or stalked, 7 sometimes out of 8, 8 and 9 stalked. Hindwings, with 4 and 5 sometimes stalked or coincident; 6 and 7 remote, 8 with one or more costal pseudoneuria, sometimes twice connected with 7.

Type.—*Boisduvalii*, Westw.

This is the predominant genus in Australia, to which additions may be expected. The species have a general resemblance to the following genus, but are separable by the position of veins 4 and 5 of hindwings.

1.	Thorax orange, antennæ orange	...13	*melanodes*
2.	,, ,, ,, black ...	...14	*xanthochrysa*
3.	Basal half of forewings black ...	...16	*zophopepla*
4.	,, ,, ,, not black	...18	
5.	Forewings fuscous, thorax orange-fuscous	15	*Boisduvalii*
6.	,, ,, ,, fuscous	...19	*gymnophasa*
7.	Forewings pale ochreous-grey ...	...20	*lurida*
8.	,, nearly black	...13	
9.	Forewings hyaline, base black ...	...17	*hyaloscopa*
10.	,, uniform grey-whitish	...18	*grisea*

13. P. melanodes, n. sp.

♂, 32 mm. Head, thorax, antennæ, and abdomen bright orange-ochreous, both above and beneath, antennal pectina-

tions at greatest length 6. Legs orange-ochreous, tarsi slightly infuscated. Forewings, elongate moderate; costa nearly straight, arched towards apex, termen oblique, not rounded; dull transparent-whitish, minutely irrorated with black, which coalesces on basal half of wing so as to appear black; veins outlined with dull fuscous; cilia ochreous. Hindwings with costa rather strongly arched, apex somewhat prominent, termen gently rounded; dull fuscous, semi-transparent; dorsal hairs blackish; at base yellowish; cilia as in forewings.

Case and *Larva*.—Unknown.

Mackay (R. E. Turner), Cape York (C. French), Queensland. Two specimens.

14. P. XANTHOCHRYSA, n. sp.

♂, 32 mm. Head, thorax, abdomen, and legs bright orange-ochreous, hairs of orbital rims black, antennæ black, pectinations at greatest length 6. Forewings elongate, moderate; costa nearly straight, slightly sinuate before middle, termen gently and obliquely rounded; pale fuscous, semi-transparent; cilia fuscous. Hindwings, with apex rounded, termen rounded, continuous with apex; colour as in forewings; cilia as in forewings.

Case and *Larva*.—Unknown.

Recognized by the black antennæ.

Perth, Western Australia. One specimen received from Mr. S. Angel; taken in November.

15. P. BOISDUVALII, Westw.

Oiketicus Boisduvalii, Westw., P.Z.S. Lond., p. 232, t. 37, fig. 2 (1854); (?) *Lomeria B.*, Walk., Cat. Lep. Het., iv., 967 (1855).

♂, 28 mm. Head, thorax, and abdomen dark ochreous, tinged with fuscous, face fuscous, thorax beneath and hairs of orbital rings blackish. Legs ochreous-fuscous. Antennæ fuscous, pectinations ochreous-fuscous, at greatest length 6. Forewings elongate, moderate; costa very slightly arched, not sinuate, termen oblique, faintly rounded; light fuscous, semi-transparent; cilia light fuscous. Hindwings with apex rounded, termen rounded continuous with apex; colour and cilia as in forewings.

Case and *Larva*.—According to Mr. W. W. Froggatt (Misc. Pub. Dep. Agric., No. 337) the case of this species is "a slender elongate-oval case, about 2 inches in length, thickly covered with short bits of stick, closely attached to the silk, so that it is quite stiff. The larvæ feed on several species of low shrubs around Sydney."

The perfect insects appear to be scarce. This species is allied to the preceding, but differs by the blackish face and blackish thorax beneath, besides being smaller and narrower-winged.

Blackwood, South Australia. One specimen.

16. P. zophopepla, n. sp.

♂, 30 mm. Head, thorax, and antennæ orange-ochreous, posterior half of thorax infuscated. Antennal pectinations at greatest length 8; orange-ochreous, very short on terminal half. Legs ochreous-fuscous. Abdomen ochreous. Forewings elongate, moderate. Costa slightly arched, not sinuate, termen oblique, hardly rounded; dull whitish, semi-transparent on posterior half of wing, basal $\frac{2}{3}$ of wing minutely irrorated with dark fuscous, which coalesce on basal half so as to appear black; cilia dull ochreous. Hindwings with apex rounded, termen rounded continuous with apex; colour and cilia as in forewings.

Case.—Cylindrical, 25 to 35 mm. long; diameter, 10 mm. Dull white, white in some species; wholly or nearly wholly thickly ornamented with leaves of *Euclayptus*, and with one or two thin, long twigs protruding from 1 to 2 inches beyond posterior extremity of sac. This is the general form, but some are more meagrely ornamented with pieces of grass-stems, varying from 10 to 40 mm. in length, whilst others are ornamented with both leaves and stems, scarcely two (out of 20) being alike. Very similar in appearance to *Melanodes*, but appears to differ by the narrower and longer forewings, and different-shaped hindwings.

Mackay (R. E. Turner) and Townsville (Dodd), Queensland. Several specimens; received in December.

17. P. hyaloscopa, n.sp.

♂, 30 mm. Head, thorax, antennæ, abdomen, and legs blackish, thorax lighter in middle, antennal pectinations at greatest length 8, black (imperfect). Anal tuft ochreous. Forewings elongate moderate, costa nearly straight, termen unevenly rounded, oblique; hyaline, semi-transparent, basal third and costal edge sprinkled with fine linear blackish scales; cilia fuscous. Hindwings with apex feebly prominent, termen unevenly rounded; colour, markings, and cilia as in forewings, but costal edge with markings broader and better defined; dorsal hairs black.

Case and *Larva*.—Unknown.

Very distinct by the almost clear wings. North-west Vic-

toria. One specimen; beaten from *Casuarina*, sp.; in November.

18. P. GRISEA, Heyl. *(Chalia grisea*, Heyl.).

Ann. Soc. Ent. Belg., xxix., p. cxx. (1886).

♂, 20 mm. Head, thorax, antennæ, legs, and abdomen pale dull ochreous, face darker, a tuft of whitish hair at base of antennæ beneath, antennal pectinations at greatest length 8, much shorter on apical third. Forewings elongate, moderate, costa nearly straight, apex rounded, termen gently bowed, oblique; dull grey-whitish, semi-transparent, along costal edge somewhat ochreous, extreme costal edge fuscous; cilia greyish. Hindwings with termen evenly rounded; colour and cilia as in forewings; dorsal hairs ochreous.

Case and *Larva*.—Unknown.

An obscure species; the specimen not being in the best of condition, the description may require a slight amendment.

Broken Hill, New South Wales. One specimen; at light; in March.

19. P. GYMNOPHASA, Low.

O. gymnophasa, P.L.S. N.S.W., p. 39, 1900.

♂, 20 mm. Head, palpi, antennæ, thorax, legs, and abdomen fuscous, face darker fuscous, thorax darker anteriorly. Antennal pectinations fuscous, at greatest length 8. Forewings elongate, moderate, costa nearly straight, apex rounded, termen gently bowed, oblique; fuscous, slightly darker around margins; cilia fuscous. Hindwings with termen rounded; colour and cilia as in forewings.

Case and *Larva*.—Unknown.

Allied to the preceding; in fact, the two were formerly described under the one name, but more material having come to hand, the differences are apparent. Apart from the colour the antennæ in the present species is almost even throughout; in *grisea*, however, it is much shorter on apical third.

Broken Hill, New South Wales. One specimen; in October. Also from Melbourne and Ararat, Victoria (Hill).

20. P. LURIDA, Heyl.

Chalia lurida, Heyl., Ann. Soc. Ent. Belg., xxix., p. cxx., 1886.

♂, 20 mm. Head, thorax, and abdomen ochreous-grey, face fuscous, base of antennæ pale ochreous-grey, thorax beneath fuscous. Antennæ fuscous, pectinations pale fuscous, at greatest length 8, much shorter on apical $\frac{1}{6}$. Legs pale ochreous-grey. Forewings elongate, moderate, costa nearly straight, apex rounded, termen gently rounded, oblique; pale ochreous-grey, thickly clothed with greyish hairs, except on pos-

terior third, and around termen, which is more thinly scaled and semi-transparent; cilia greyish, becoming fuscous on basal half. Hindwings with apex round, termen rounded continuous with apex; colour and cilia as in forewings, but wings more thinly scaled; dorsal hairs pale greyish-ochreous.

Case and *Larva*.—Unknown.

Differs from the other species especially by the density of scales and woolly appearance.

Duaringa, Queensland. One specimen. The type came from Cape York, Queensland.

6. Paracharactis, n. g.

Antennæ bipectinated to apex, abdomen moderate. Forewings with one or two dorsal pseudoneuria, 1c very slight, free, 4 and 5 connate or short-stalked, 8 and 9 stalked, 10 sometimes out of 8. Hindwings with 4 and 5 connate, 6 and 7 remote, 8 with a costal pseudoneuria.

Type.—*Cautopsis*, Low.

The species of this genus bear a superficial resemblance to the preceding genus. Structurally, however, they differ in having vein 1c (though slight) free.

1. Thorax greyish-fuscous, antennæ black	21	*Leeuwinii*
,, not ,, ,, ,,	22	
2. Head and face orange	24	*delocephala*
,, orange, face blackish	21	
3. Forewings blackish-fuscous	22	*cautopsis*
,, ochreous-fuscous	23	*erionota*

21. P. Leeuwinii, Heyl.

Eumeta Leeuwinii, Heyl., Ann. Soc. Ent. Belg., xxix., p. cxlviii., 1886.

♂, 30 mm. Head, thorax, abdomen, and legs grey, face fuscous fillet orange, anterior tibiæ and tarsi blackish, antennæ fuscous, pectinations at greatest length 6. Forewings elongate, moderate, costa nearly straight, termen gently rounded, oblique; greyish-fuscous, darker along margins; cilia grey. Hindwings with apex rounded, termen rounded; colour and cilia as in forewings; dorsal hairs dull ochreous.

Case and *Larva*.—Unknown.

Broken Hill, New South Wales. One specimen.

22. P. cautopsis, n. sp.

♂, 28 mm. Head, thorax, and abdomen dull rufous-orange, abdomen more fuscous tinged, face blackish. Antennæ blackish, strongly bipectinated to apex, pectinations at greatest length 6. Legs ochreous, mixed with fuscous. Forewings rather short, costa nearly straight, apex slightly rounded, ter-

men somewhat oblique, very little rounded; uniform blackish-fuscous, darker along termen; cilia blackish. Hindwings with apex rounded, termen rounded, continuous with apex; colour and cilia as in forewings; dorsal hairs blackish.

Case and *Larva*.—Unknown.

Differs from any other of the described Australian species by its sooty-black colouring.

Newcastle, New South Wales. One specimen; in November.

23. P. ERIONOTA, Low.

Oiketicus erionota, Low., T.R.S. S.A., p. 63, 1901.

♂, 30 mm. Head, palpi, and thorax yellow-ochreous, face ochreous, antennæ fuscous, pectinations black, at greatest length 6. Legs and abdomen light fuscous ochreous-tinged. Forewings elongate, moderate, costa nearly straight, slightly sinuate before middle, apex rounded, termen gently bowed oblique: ochreous-fuscous, pale ochreous grey in some specimens; cilia greyish-fuscous. Hindwings with apex slightly prominent, termen rounded, continuous with apex; colour and cilia as in forewings.

Case and *Larva*.—Unknown.

In the former description of this species the characters were drawn from an abraded specimen. Having recently captured two more we are enabled to re-describe the species more accurately.

Broken Hill, New South Wales. Three specimens; in March and May.

24. P. DELOCEPHALA, n. sp.

♂, 32 mm. Head and face orange-yellow. Thorax, abdomen, and legs brownish-ochreous, fuscous-tinged, thorax lighter anteriorly, fillet orange. Antennæ ochreous-fuscous, strongly bipectinated to apex, pectinations black, at greatest length 6. Forewings elongate, moderate, costa nearly straight, apex rounded, termen bowed, oblique; smoky-brown, darker around margins; cilia rather long, smoky-fuscous. Hindwings with apex rounded, termen rounded, continuous with apex; colour and cilia as in forewings.

Case and *Larva*.—Unknown.

Very distinct by the orange head and face.

Sydney, New South Wales. One specimen.

The following species are wrongly referred to the *Psychidæ*, or unknown to us, viz.:—

Psyche albifrons, Wallenger.

Eumeta Ernesti, Heyl. (prob. = præc.).

Genduara cinerea, Walk.

Panisa circumdata, Walk.

Psychanisa circumdata, Walk.

Entometa ignobilis, Walk. See No. 6.

Cebysa conflictella, Walk., belongs to the *Tineidæ*.

Oiketicus bicolor. Luc., P.L.S, N.S.W., p. 137, 1893. (*Oeceticus bicolor*, Luc.)

"♂, 26 mm. Head, thorax, and abdomen ferruginous-ochreous. Antennæ black, midrib white, pectinations narrowing at base and apex. Forewings with costa gently rounded, hindmargin rounded; light ochreous-drab or mouse colour, thinly scaled, veins darker; cilia darker or a more fuscous drab. Hindwings as forewings.

"Victoria. An unpretentious-looking insect, the centre ferruginous-ochreous, being the more conspicuous because of the sombre-looking wings." Unknown to us.

Oiketicus felinus, Luc. (*Oeceticus felinus*, Luc.), Proc. Roy. Soc. Queensland, p. 140, 1899.

"♂, 28 mm. Head fuscous, face wool-white. Palpi and antennæ fuscous. Thorax creamy-grey, with anterior band, dorsal and lateral bands rich velvety-fuscous, inclining to black. Abdomen ferrous-red, freely covered with rich, velvety black hairs, caudal segment ferrous-red. Forewings elongate, gently dilate, costa gently rounded, hindmargin obliquely rounded; hyaline, with veins rich velvety fuscous; cilia blackish fuscous. Hindwings and cilia as in forewings. ♀, apterous. Builds its domicile in *Casuarina* needles. A ♀ (bred) was visited by two males, and so taken. May Orchard, Brisbane." Unknown to us.

Oiketicus Macalisteri, Macal., Proc. N. Hist. Soc. Dublin, p. 134 (1867). This is *Talaeporia magnella*, Walk. (Tineidæ).

Eurycyttara (Hamps.), *Macleayii*, Guild; *Oiketicus Macleayii*. Guild. T.E.S., Lond. xv., p. 375, t. 8 (1827); Westw., P.Z.S., p. 222, t. 34, fig. 3 (1854).

The type is unique, and is in the British Museum. We were unable to make a proper examination of the type, but the following are notes on it:—

Expanse, about 17 mm. Wings shaped much as in *Clania tenuis*, Rosen. Head, antennæ, etc., and all wings wholly dark fuscous; thorax slender. Westwood gives the neuration as follows:—In forewings only 10 terminal branches, the third branch of the sub-costal and the upper discoidal being obsolete,

and the lower discoidal rises conjointly with third branch of median from lower angle of cell, *i.e.*, as we understand 4 and 5 stalked, 6 absent, 9 absent.

Described from type in British Museum.

We would like to take this opportunity of expressing our thanks to Messrs. J. Kershaw (Melbourne Museum), J. G. O. Tepper (Adelaide Museum), W. W. Froggatt (Technological Museum, Sydney), G. Lyell, F. P. Dodd, and Miss May Wise for their generous assistance by the loan and gift of specimens.

Three New Species of Orchid.

By R. S. Rogers, M.A., M.D.

[Read October 1, 1907.]

Plate XXVI.

Diuris palachila, *sp. nov.*

This species has long been familiar to members of the Field Naturalists' Section of the Royal Society, under the name of *Diuris intermedia*, but has never been described, owing to the opinion which seemed to prevail in the Section that it was a hybrid. It is, however, a distinct and well-marked form, appearing regularly in considerable numbers in certain localities. The earliest date on which I have collected it is September 10, at Blackwood. I have also recorded it from Port Victor, Belair, Black Hill, Gandy's Gully, Barossa, and other parts of the State. The name *intermedia* was applied to it, because it was supposed to occupy an intermediate position between *D. maculata* and *D. pedunculata*. Its nearest ally is, however, *D. setacea*, a western species, and I have, therefore, thought it inadvisable to perpetuate a name founded on a misapprehension. I have called it *D. palachila*, owing to the spade-shaped form of the central lobe of the labellum.

Plant varies from 4 to 15 inches high.

Leaves narrow-linear to linear, often 7 inches long. A *bract* subtends the pedicel of each flower, and two or more long, closely-sheathing bracts are to be found on the stem.

Flowers.—1-3 on fairly long pedicels. Lateral sepals green, linear-acuminate, about same length as lateral petals, with a tendency to cross as in *D. maculata*. Dorsal sepal more or less ovate, closely embracing the column below, about same length as labellum; yellow, generally with reddish-brown or purplish blotchings or dots showing chiefly on the outer surface, near the base and around the margins. Lateral petals elliptical, markedly stalked, yellow, or with markings of similar colour and disposition as in the case of dorsal sepal.

Labellum.—3-partite, the clefts between the lobes not reaching to within less than a line of the base. Lateral lobes rather more than half as long as central lobe, triangular, and usually dentate on outer margin. Central lobe spade- or shovel-shaped; entire margin; two widely-separated, raised, longitudinal lines on its stalk, fusing on the lamina into a single well-marked raised line, which extends to the apex.

Labellum, with dark-purplish or reddish-brown blotchings, especially on its under-surface.

Lateral appendages of column subulate, reaching rather higher than the anther tip. Stigmatic surface extensive and somewhat heart-shaped, with rostellum placed high up in front of and below the anther.

The leaves of this species are relatively longer and wider than in *D. setacea;* the lateral lobes of the labellum are not so wide, and the clefting does not extend nearly so deeply; the middle lobe is not so markedly stalked; the two raised lines are much more widely separated; and the lateral appendages of the column are relatively longer. In other respects, the two species closely approach each other.

Caladenia gladiolata, *sp. nov.* Pl. xxvi.

A somewhat stunted hirsute species, varying from 3-7 inches high, found at Hornsdale, near Appila-Yarrowie, September 10, 1907, in poor soil.

Leaf.—Hairy, varying in shape and size from ovate-lanceolate to oblong-lanceolate.

Bracts.—Two, one subtending the flower.

Flower.—Usually solitary, rarely two; greenish-yellow with red markings; varies in diameter according to size of plant.

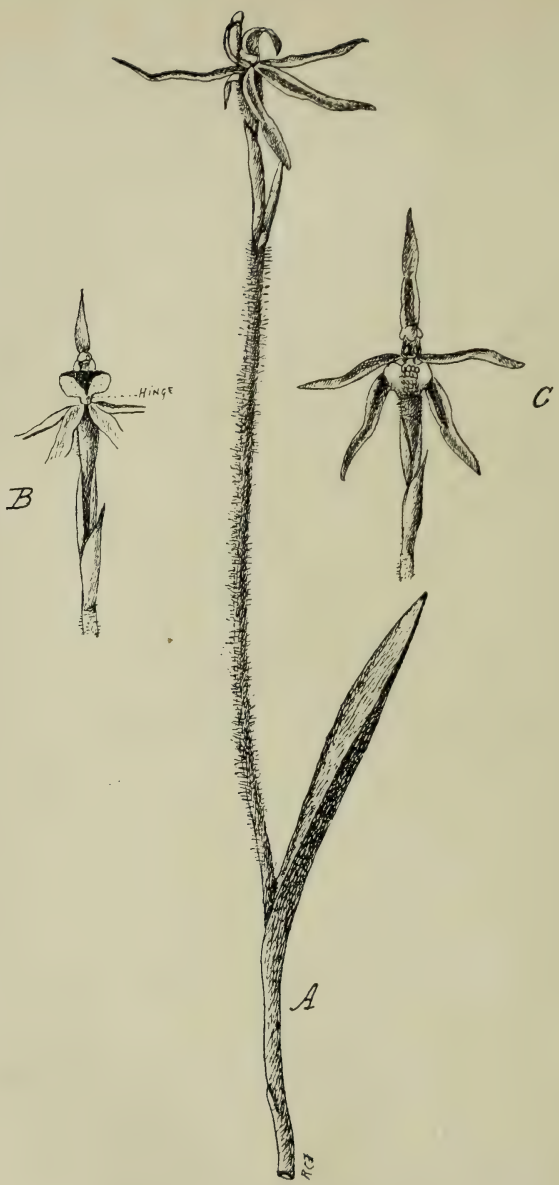
Petals.—Linear-lanceolate, rather shorter than sepals; yellowish-green, with red stripe down centre.

Sepals of about equal length and appearance; lateral ones flattened throughout, constricted about one-third from distal end, the distal third being fluted, reddish-brown in colour, glandular- and bayonet-shaped (from which character the species has been named); reddish vein running down centre of dilated proximal two-thirds. Dorsal sepal incurved, with rather clavate point.

Labellum on a movable hinge, ovate, recurved at tip. Lateral lobes semicircular, usually entire or slightly dentate anteriorly; yellowish-green. Middle lobe, reddish-brown, crenulate. No sign of veining on labellum. Calli large piriform, dark reddish-brown, in 4 crowded somewhat irregular rows, occupying posterior two-thirds of middle lobe.

Column widely winged in its upper part, wings tapering off towards the base, much incurved. Anther shortly pointed, horizontal. Two oval glands at base of column. Stigmatic surface just below the anther.

This *Caladenia* is a near ally of *C. clavigera* and *C. tesselata*, Fitz., both eastern species. From the former it differs in the absence of clavate points to lateral sepals, in the shape and appearance of the calli, in the wide winging



Hussey & Gillingham, Printers, Adelaide.

of the column, and in the oval glands at base of column (they are globular in *clavigera*). From the latter it may be distinguished by the facts: that the calli do not appear on the tip of the labellum, that the labellum is recurved, and that the leaf is not narrow.

DESCRIPTION OF PLATE XXVI.

CALADENIA GLADIOLATA, *sp. nov.*

A. Plant about natural size, showing bayonet-pointed lateral sepals. (Lateral aspect.)
B. Shows dorsal sepal and hinged labellum with recurved tip.
C. Flower, from the front, showing the four rows of crowded calli on lamina.

[Read September 9, 1907.]

Caladenia tutelata, *sp. nov.*

On October 2, 1906, I read a paper before this Society describing a new *Caladenia*, found at Blackwood, by Mr. A. Keith Ashby. Only two specimens were available for examination, and, consequently, it was uncertain whether this interesting form should be regarded as a hybrid between *Caladenia deformis* and *Glossodia major*, or whether it was really a new species. Fresh discoveries on August 24 of this year have removed this uncertainty, and I am now able to record an entirely new species, which I have called *Caladenia tutelata*, on account of the tall sentinel calli which appear to guard the entrance to the column. These calli were described in my former paper as being about $\frac{1}{8}$ inch in height, clavate at their free extremities, and standing erect in a row at the base of the column.

In this supplementary note I would like to add that an examination of further specimens shows a strong tendency for these calli to cohere or fuse together. In two specimens they were fused into two broadly-filamented, double-headed calli. In another specimen all the filaments were coherent, forming a vertical plate in front of the column. Such fusions are extremely interesting from a developmental standpoint, as they appear to me to throw light upon the origin of the appendages in the genus *Glossodia*, which have probably arisen in an identical manner. In four out of five species of *Glossodia*, the appendages are two in number, with clavate points; and in the case of one of these, *G. intermedia*, Fitz., these clavate points are slightly bifid, indicating their probable origin from four calli. In the fifth, *G. major*, the top of the single appendage is bifid, but the

width of the plate is suggestive of more than two filaments having entered into its composition.

C. tutelata is distinctly a transitional form between the *Caladenias* and the *Glossodias*, and emphasizes the point raised in my former paper, as to the wisdom of separating these two genera in a natural classification.

In colour, this species more nearly approaches *G. major* than *C. deformis*. The two rows of golfstick calli are generally well defined as far as the middle of the labellum, where they merge into still smaller calli of less regular distribution. The margin of the labellum is unfringed.

There were no *Glossodias* yet in bloom in the gully where these specimens were discovered, and one had to search diligently for an odd specimen in other parts of the ranges. The early date of blooming, therefore, of the new species, would alone put the question of hybridization practically out of court.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part VI.

By Jos. C. Verco, M.D. (Lond.), F.R.C.S. (Eng.).

[Read August 6, 1907.]

Plates XXVII. and XXVIII.

Sepia braggi, *sp. nov.* Pl. xxvii., figs. 6, 6*a*, 6*b*, 6*c*, 6*d*.

The animal from which this cuttlebone comes is unknown. It is 60 mm. long by 11 mm. broad at its widest part, with a maximum thickness of 4·75 mm. The dorsal surface is very slightly convex in its anterior two-thirds, but markedly curved in the posterior third. The mucro of 2·75 mm. in length projects at an angle of about 135°. The maximum width and thickness is at 20 mm. from the anterior end, which is sharply rounded. Posteriorly it uniformly narrows to a minimum of 3 mm., and at its extreme end terminates in a thin circular expansion, 4 mm. in diameter, which extends about 1·5 mm. beyond the base of the projecting spine.

An orange-coloured line arises at the margins at the point of maximum width, and becomes plainer and wider as it extends backwards, and more prominent ventrally till it projects nearly a millimeter in height, and is half a millimeter in width at the posterior end of the white substance, around which it circles. A longitudinal central furrow deepest just in front of the widest part of the shell, grows shallower and wider anteriorly, and nearly vanishes at the posterior end. Dorsally a very low rounded central rib increases posteriorly to a width of 3 mm., and midway between it and the margins of the bone is a scarcely perceptible longitudinal depression.

Its nearest ally is *S. elongata*, Fer and Orb, Céph Seiches, t. 24, f. 7-10, 1839; Tryon, Man. Conch., vol. i., p. 195, pl. xci., figs. 418, 419. *Hab.*, Red Sea. The animal of that species is also unknown. The sepiostaire as figured in Tryon is only 45 mm. long, is less attenuated posteriorly, has a comparatively wider hollow expansion at the posterior end, is curved for a much shorter length posteriorly, and has its spine not set at an angle, but curving backward, so as to continue the nearly straight dorsum of the bone. The chalky substance, too, seems much thicker, and to more suddenly decrease forward. The dimensions are not given in Tryon's text.

Hab.—The type was found at Glenelg by Master Bragg, and we have pleasure in naming it after him, and at the same time complimenting his father, Prof. Bragg, one of our most honoured Fellows, who has just been distinguished by the Fellowship of the Royal Society of London.

Mr. Zietz has also taken eight specimens during ten years' collecting on our beaches; so that it is a rare species here.

Mr. Hedley says it does not seem to occur on the Pacific coast of Australia, but he has it from Victoria.

Arcularia dipsacoides, Hedley. Pl. xxix., fig. 13.

Arcularia dipsacoides, Hedley, Records Austr. Mus., vol. vi., part 5, 1907, p. 359, pl. lxvii., f. 21. Type locality, 800 fathoms 35 miles E. of Sydney.

Dredged off Cape Jaffa, in 130 fathoms, 41 examples; in 300 fathoms, 10, all dead.

Two individuals were taken alive in 130 fathoms, off Cape Jaffa, and furnished radulæ. They contain about fifty-three rows, and are of the ordinary rachiglossa type. A large lateral with two well-curved simple cusps fold over a rachidian tooth with ten cusps, of which the outermost on each side is very small. In one individual, one cusp situated at the centre is the largest and has frequently five cusps on one side and four on the other. In the second individual, the middle two are largest. The rest vary very much in relative length in different rows, so that scarcely any two rachidian teeth exactly correspond.

Vermicularia flava, n. sp. Fig. 1.

Fig. 1.

Shell an ochre-yellow-coloured tube, varying in diameter from 1 to 1·5 mm., moderately thick, coiled in flat discs of 5 or 6 mm. in diameter, each formed of three or four spirals; the discs are superimposed to form a cylinder. Section of tube circular. Surface has sinuous growth-lines. Ante-current at the margins of attachment to adjacent coils and at the centre of the free surface, varying in validity, sometimes erected into a collar. The anterior end stands free.

The type, after forming a flat cylinder of two discs, produces two more discs at right angles to these, and then has a free tube of 7 mm. length. The discs may be formed from the centre outwards, or from the circumference inwards. The

free portion may be 15 mm. long. No nucleus has been seen.

Type locality.—130 fathoms, off Cape Jaffa; also in 90 fathoms, 37 dead; in 40 fathoms, off Beachport, one dead.

Mangilia spica, Hedley.

Records of the Austr. Mus., vol. vi., pt. 4, 1906, p. 297, pl. lv., fig. 20. Type locality, off Narrabeen, N.S.W., 80 fms., 2 examples, 100 fms., off Wollongong 1.

Dredged at 40 fathoms, off Beachport, one dead; and at 110 fathoms, one dead.

The South Australian shells vary from the type in having six spirewhorls instead of four; and the four earlier whorls are not quite so long as those which form the spire of the type, the axial ribs are more numerous, and are less marked below the suture.

Drillia hecatorguia, n. sp. Figs. 2 and 3.

Shell small, stout, biconic, whorls six. Protoconch flat, two smooth convex turns. Spirewhorls with a sharp medial angulation, undulated by pliciform tubercles (nine in the penultimate) plicæ reaching the lower suture; suture slightly adpressed. Growth-lines microscopic. Bodywhorl half as long as the shell; excavated below the suture, then acutely angled; faintly concave immediately below the angulation, then scarcely inflated, and next roundly contracted in the lower third. Tubercular plicæ wide, extend from the angle, soon become obsolete. Growth-lines faint, rude near the aperture. Sinus half as deep again as wide, bounded by the angle. Aperture oblique, length nearly four times its width, elongate-oblong. Outer lip simple, thin, convex. Columella convex in posterior half, straight anteriorly. Inner lip thin, applied, slightly spread, extending to suture. Anterior notch moderately wide. Colour translucent white, faintly tinged with brown.

Fig. 2.

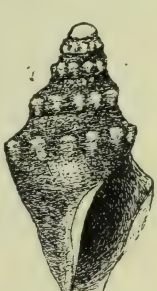


Fig. 3.

Dim.—Length, 6·1 mm.; breadth, 2·8 mm. Length of aperture, 3·2 mm. The largest example is 7 mm. long.

Type Locality.—104 fathoms, 35 miles south-west of Neptune Islands; 28 dead.

Nucula micans, Angas.

Nucula micans, Angas. Proc. Zool. Soc., Lond., 1878, p. 864, pl. liv., f. 16. Type locality, shell sand, Salt Creek; Glenelg, St.

Vincent Gulf: Tate, Trans. Roy. Soc., South Australia, 1887, vol. ix., p. 102, No 125; Tate and May, Proc. Linn. Soc., N.S. Wales, 1901, vol. xxvi., part 3, p. 435, "Tasmania"; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xvii. (N.S.), part 1, p. 237, "Victoria."

Locality.—Taken on the beach at MacDonnell, Rivoli, and Guichen Bays; many dredged alive in 5 fathoms, St. Vincent Gulf, and in 20 fathoms Backstairs Passage; valves dredged in Spencer Gulf, and also in 40 and 150 fathoms off Beachport, and one valve in 130 fathoms off Cape Jaffa.

Nucula beachportensis, *sp. nov.* Pl. xxvii., fig. 3.

Oval-trigonal, moderately solid. Umbos prominent, inflated, slightly opisthogyre, incurved. Teeth about thirteen anterior, solid and curved; six posterior. Fossa for the internal cartilage rather small, directed forwards and inwards. Dorsal border very slightly excavate just behind the fossa, then convex, then straight to the posterior inferior angle; ventral border with a uniform curve, joining with a smaller curve the anterior dorsal border, which has a very slight convex arcuation, and is about twice as long as the posterior. Inner ventral margin minutely crenulate.

Sculpture.—Smooth, but for obsolete rounded concentric striæ at irregular distances, and scanty microscopic radial striæ.

Dimensions.—Umbo-ventral, 4·6 mm.; antero-posterior, 4·9 mm.

Locality.—Dredged off Beachport, 40 fathoms, 1 perfect (type), 2 valves; in 100 fathoms, 1; 150 fathoms, 2; 200 fathoms, 1; off Cape Jaffa in 130 fathoms, 1; 300 fathoms, 6; all dead.

Diagnosis.—It is very like *N. micans*, Angas, but is a larger shell, is smoother, is not so uniformly rounded behind, but is truncated or straight from the end of the hinge to the ventral border, and the crenulations are fewer and more valid.

Nucula obliqua, Lamarck.

Nucula obliqua, Lamarck. Anim. s. Vert., 1819, vol. vi., p. 59; Chenu, Man. Conch., vol. ii., 1862, p. 179, f. 897; Hedley, Mem. Austr. Mus., 1902, iv., p. 292. *N. tumida*, Ten. Woods. Proc. Roy. Soc. Tasm., 1877 (1876), p. 111 *(non* Phillips, Illus. Geol. Yorkshire, 1836, part 2, pl. v., f. 15; *nec* Hinds, Proc. Zool. Soc., Lond., 1843, p. 98). Type locality, Eocene fossil, Table Cape, Tasm. *N. tenisoni*, Pritchard, Proc. Roy. Soc. Vict., 1896, vol. viii., p. 128.

Dredged off Cape Jaffa, in 90 fathoms, 1 valve; in 130 fathoms, 16 valves; in 300 fathoms, 1 alive, small, and 3 valves; off Beachport, in 110 fathoms, 34 valves; in 150 fathoms, 19 valves; in 200 fathoms, 24 valves.

Leda crassa, Hinds.

Nucula crassa, Hinds, Proc. Zool. Soc. Lond., 1843, p. 99. Type locality, Australia; *Leda crassa*, Hinds, Sowerby, Thes. Conch., vol. iii., 1860, p. 120, pl. 228, f. 69; Sowerby, Conch. Icon., 1871, vol. xviii., pl. 5, f. 27; Angas, Proc. Zool. Soc. Lond., 1877, p. 193; Ten. Woods, Proc. Roy. Soc. Tasm., 1878, p. 32; E. A. Smith, Chall., Zool., 1885, xiii., p. 237; Tate, Trans. Roy. Soc. South Austr., 1887, ix., p. 102, No. 126; Tate & May, Proc. Linn. Soc. N.S. Wales, 1901, xxvi., pt. 3, p. 435; Hedley, Mem. Austr. Mus., 1902, iv., pt. 5, p. 294; Pritchard & Gatliff, Proc. Roy. Soc. Viet., 1904, xvii. (N.S.), pt. 1, p. 238. *Leda chuva*, Gray in Juke's Voy. Fly., 1847, vol. ii., app. p. 356, pl. ii., f. 6; Sowerby, Thes. Conch., 1860, iii., p. 119, pl. 228, f. 67; Sowerby, Conch. Icon., 1871, xviii., pl. 7, f. 46.

Dredged, Investigator Strait, 14 fathoms, 8 alive; off Middleton, 17 fathoms, many alive, adult; 18 miles off Newland Head, in 26 fathoms, 24 alive, mostly small, and great numbers of very small examples; off Beachport, in 110 and 150 fathoms, 3 and 4 valves (Dr. Verco).

Leda dohrni, Hanley.

Leda dohrni, Hanley, Proc. Zool. Soc. Lond., 1861, p. 242. Type locality, Mare Pacificum (Mus. Dohrn). *Id.* Hedley, Thetis Exped., Memoirs Austr. Mus., iv., pt. 5, 1902, p. 294. *Leda dohrnii*, Hanley (A. Ad.), Sowerby, Conch Icon., xviii., 1871, Leda, pl. lx, f. 54. *Leda hanleyi*, Angas, Proc. Zool. Soc., 1873, p. 174, pl. xx., f. 7; *teste* Hedley, *loc. cit.*

Dredged off Beachport, in 110 fathoms, 6 valves; in 150 fathoms, 10 valves; off Cape Jaffa, in 130 fathoms, 7 valves (Dr. Verco).

Leda verconis, Tate.

Leda verconis, Tate, Trans. Roy. Soc. South Austr., 1891, vol. xiv., p. 264, pl. xi., fig. 4.

Dredged alive in Spencer's Gulf, as far up as Wallaroo Bay, also in St. Vincent Gulf, in Investigator Strait, and Backstairs Passage. It occurs alive at all depths from 8 to 22 fathoms, being very numerous at 8, at 15, and at 22 fathoms. None were taken in the depths from 45 to 300 fathoms.

Leda pala, Hedley.

Leda pala, Hedley, Records Austr. Mus., vol. vi., part 5, 1907, p. 361, pl. lxvi., fig. 1. Type locality, 800 fathoms E. of Sydney.

Dredged off Cape Jaffa, in 130 fathoms, 2 valves.

Leda miliacea, Hedley.

Leda miliacea, Hedley, Thetis Exped., Mem. Austr. Mus. iv., pt. 5, p. 295, fig. 43: valves, 63-75 fathoms off Port Kembla, and 41-50 fathoms off Cape Three Points.

Dredged in 300 fathoms off Cape Jaffa, 5 valves (Dr. Verco).

Poroleda ensicula, Angas.

Leda ensicula, Angas, Proc. Zool. Soc., 1877, p. 177, pl. xxvi., f. 27. Type locality, off Port Jackson Heads, 45 fathoms. *Id.*, Smith, Chall. Rep. Zool., xiii., 1885, p. 239. *Id.*, Hedley, Thetis Exped., Mem. Austr. Mus., iv., pt. 5, 1902, p. 293, fig. 41. *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vic., xvii. (N.S.), pt. 1, 1904, p. 239.

Dredged off Beachport, in 100 fathoms, 2 valves, in 110 fathoms 12 valves, in 150 fathoms very many valves, in 200 fathoms 8 valves; off Cape Jaffa, in 90 fathoms 5 valves, in 130 fathoms 6 valves; off Cape Borda, in 60 fathoms 2 valves.

Sarepta obolella, Tate.

Leda obolella, Tate, Trans. Roy. Soc. S. Austr., vol. viii., 1886, p. 129, pl. v., figs. 3*a* and *b*. Type, a tertiary fossil from Muddy Creek. *Sarepta tellinæformis*, Hedley, Records Austr. Mus., 1901, vol. iv., p. 26, fig. 8; 75 fathoms 5 miles E. of Sydney Heads. *Sarepta obolella*, Tate; Hedley, Memoirs Austr. Mus., 1902, vol. iv., part 5, p. 295; off Port Kembla 63-75 fathoms, and Cape Three Points 41-50 fathoms.

Dredged off Cape Jaffa, in 300 fathoms, 1 whole, 6 valves.

Limopsis tenisoni, Ten. Woods.

Limopsis cancellata, Ten. Woods (*non* Reeve), Proc. Roy. Soc. Tasm., 1877 for 1876, p. 156. Type locality, north coast of Tasmania. *L. tenisoni*, Ten. Woods, Proc. Roy. Soc. Tasm., 1878 for 1877, p. 56; Hedley, Memoirs Austr. Mus., vol. iv., part 5, p. 297; Pritchard & Gatliff, Proc. Roy. Soc., Vic., 1904, vol. xvii. (N.S.), part 1, p. 245, "Victoria." *L. bassi*, E. A. Smith, Chall. Zool., 1885, vol. xiii., pp. 14, 256, pl. xviii., f. 6-6*a*, "East Moncœur Is., Bass Strait, 38 fathoms"; Tate, Trans. Roy. Soc. S. Austr., 1887, vol. ix., p. 103, No. 136, "South Australia"; Tate and May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., part 3, p. 437.

Is abundant throughout St. Vincent and Spencer Gulfs, Investigator Strait, and Backstairs Passage, being taken alive at all depths from 10 fathoms up to 30 fathoms. One example was taken alive from 55 fathoms off Cape Borda, and valves have been dredged at all depths up to 130 fathoms off Cape Jaffa; none beyond this depth.

It is a very variable species. Some individuals are almost orbicular, others are extremely oblique, some have the radial sculpture very valid, others obsolete. The epidermis may be smooth, silky, and uniform, or disposed in marked concentric fringes. The brown colouration may be very deep and general, or only in certain parts, or nearly absent. But any attempt to separate into different species is vain.

Limopsis tenisoni, Ten. Woods; var. penelevis, *var. nov.*

Pl. xxvii., fig. 5.

Shell obliquely oval. Dorsal margin nearly straight. External surface with concentric growth lines, varying in

validity, somewhat imbricating; dotted at their convex margins by short, disconnected, sublenticular radial impressions, more marked over the posterior part of the shell, and as the shell grows larger. Internal margin non-crenulated and flattened. Tooth-plate rather curved; about 14 teeth. Milk-white.

Dimensions.—Umbo-ventral, 16·5 mm.; antero-posterior, 15 mm.; sectional of the closed valves, 5·5 mm.

Locality.—Valves dredged off Cape Jaffa and Beachport from 90, 130, 150, 200, and 300 fathoms.

It differs from the ordinary form in the almost complete absence of radial sculpture.

Limopsis vixornata, *sp. nov.* Pl. xxvii., fig. 1.

Shell solid, white, equivalve, nearly equilateral, transversely orbicularly oval. Umbo acute, projecting well beyond the dorsal border, incurved. Inner margin smooth and flat. External surface smooth, but for concentric growth lines, which at fairly regular intervals are more valid, so as to form subdistant liræ. Under the lens traces of radial incisions are visible, especially over the posterior area. Cartilage pit triangular; 11 solid diverging teeth in a curved series. Interior closely radially striate.

Dimensions.—Umbo-ventral, 5·7 mm.; antero-lateral, 6·4 mm.; largest, 8·1 mm. by 9 mm. Some have a short, straight dorsal border, shorter anteriorly than posteriorly, and with the radial impressions rather more marked. One has an epidermis, worn away near the umbo, and projecting at the ventral margin for about a millimetre and a half as a continuous radially striated membrane, which on the surface of the shell breaks up into a hairy coating.

Locality. — Type from 45 fathoms, east of Neptune Islands, with 4 valves and 1 living specimen; from 49 fathoms, off Beachport, 23 valves; also at 55 and 62 fathoms, off Cape Borda, and 110 fathoms off Cape Borda.

Diagnosis.—The transversely oval shape, the prominent umbo, and the unsculptured surface separate it from *L. tenisoni*, Ten. Woods; but possibly it is only a variant.

Limopsis eucosmus, *sp. nov.* Pl. xxvii., fig. 2.

Shell solid, rather compressed, white, obliquely orbicular, slightly higher than wide. Umbos central, prominent, incurved approximate. Cartilage-pit small, triangular. Tooth-plate slightly curved; teeth, 5 anterior, 6 posterior, somewhat diverging. Inner margin flat and smooth. Interior obsoletely radially striate. Posterior muscle-scar large and long; anterior, short and narrow. Outer surface ex-

quisitely sculptured with flat concentric ribs, varying greatly in width, some twice, some four times as wide as the interspaces; others are only cords, not so wide as the intervals. They are higher on their convex than their concave edge. Numerous radial liræ, increasing by intercalation, scallop the ribs more markedly along their concave than their convex margin, forming circular depressions in the interspaces. At the anterior and posterior areas of the shell these scallops become triangular rather than circular, and so form lozenges in the interspaces. Where the radials cross the ribs, if these are very narrow, they produce a tubercle with a central radial furrow; if wide, they cross as a lira, with a central furrow, and sometimes another radial furrow is found on either side of this.

Dimensions.—Umbo-ventral, 8 mm.; antero-posterior, 7·5 mm.; section of closed valves, 3·25 mm.; largest example, 10·5 mm. by 10·3 mm.

Locality.—Type, off Cape Jaffa, from 90 fathoms, with 1 other valve; 35 miles south-west of Neptune Islands, from 104 fathoms, 62 valves.

Limopsis erectus, Hedley and Petterd.

Limopsis erectus, Hedley & Petterd, Records Austr. Mus., vol. vi., part 3, p. 224, pl. xxxviii., figs. 14, 15. Type locality, 250 fathoms, off Sydney.

Dredged 35 miles south-west of Neptune Islands, 104 fathoms, 6 valves; off Beachport, 150 fathoms, 1 valve, 200 fathoms, 1 valve; off Cape Jaffa, 130 fathoms, 17 valves, and 300 fathoms, many small and mostly poor valves, but some with epidermis. The epidermis is abundant, of flaxen, bristly setæ, long towards the ventral border.

Nuculina (Cyrilla, A. Adams, s.g.) **concentrica,** n. sp.

Pl. xxvii., figs. 4, 4*a*, 4*b*.

Minute, obliquely-oval, equivalvular, inequilateral, higher than long, moderately solid, white, smooth, with six concentric equidistant imbricating steps. Umbos prominent, prosogyre, incurved, approximate. The front side at the upper third is oblique and nearly straight, being faintly incurved; then rather suddenly roundly angulated, beyond which it is uniformly openly curved. The posterior side has a uniform gentle arcuation, and the basal outline is distinctly more sharply curved. The hinge-plate is broad. The teeth of the left valve lie in front of those in the right valve, and the left lateral tooth lies outside the right. There are six cardinal teeth in each valve, all behind a pit lying beneath and slightly in front of the umbo. The three nearest

the pit are nearly vertical and laminar, and rather close together; especially the first two; the posterior three become gradually more distant, stouter especially at their outer ends, shorter, and more diverging, lying perpendicular to the curving posterior margin. The last one in the right valve is peg-shaped. Behind, there is a rather long lamellar triangular tooth. The posterior muscle-scar is very large, curved, and oval, and placed low down beyond the lateral tooth. The inner margin is smooth and simple. The shell is covered with a dark-brown, smooth, shining, closely-adherent epidermis, which wears off dead shells, remaining last about the umbos. Dead shells are translucent, milky-white.

Dimensions.—Umbo-ventral diameter, 2·5 mm.; antero-posterior, 1·9 mm.; section of closed valves, 1·6 mm.; a large example is 3 mm. by 2·3.

Habitat.—104 fathoms, 35 miles south-west of Neptunes, many alive and dead, and valves.

Some Ostracoda, taken in the same haul, are very like them.

Lissarca pubricata, Tate.

Limopsis rubricata, Tate, Trans. Roy. Soc. South Austr., 1886, vol. ix., p. 71, pl. v., fig. 6. Type locality, alive from 32 fathoms, Backstairs Passage; *op. cit.*, p. 104, No. 138; Tate and May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi.; part 3, p. 437, Pirate Bay, Tasmania; Hedley, Memoirs Austr. Mus., 1902, vol. iv., part 5, p. 297, valves, 41-50 fms., off Cape Three Points; Pritchard & Gatliff, Proc. Roy. Soc. Vict., 1904, vol. xvii. (N.S.), part 1, p. 246, Western Port.

Taken alive in Backstairs Passage, 17 fathoms; dead in St. Vincent Gulf, and off Cape Borda, in 62 fathoms, dead, but perfect. It is recorded from Cape Borda, round the coast of Victoria and Tasmania, to New South Wales.

Tate remarks:—"Probably a young shell, but not referable to any known species." Abundant material proves it to be full grown, and a distinct species. There are 5 radial flames, increasing in width as they diverge. Tate gives four.

Lissarca rhomboidalis, n. sp. Pl. xxvii., fig. 7.

Shell minute, solid, translucent, horn-coloured, ovate-rhomboid, equivalve, inequilateral, about twice as long behind the umbo as in front. Umbos prominent, round, wide, slightly prosogyre. Dorsal border faintly uniformly curved, continuing into the narrowly-rounded anterior end, and into a much more widely-curved posterior end, which is faintly truncated behind. There is a perceptible excavation where the anterior end joins the ventral border. A narrow sub-umbonal area, bounded outside by a straight, slightly prom-

inent rounded edge, is marked with numerous very close-set vertical striæ, and does not extend so far in front as behind, where it gradually narrows and vanishes. It is divided by a rather wide, shallow, subcentral triangular cartilage-pit. There are four anterior teeth perpendicular to the margin, and four posterior convexly curved towards the umbo; three or four small marginal teeth inside the anterior end, four at the post-dorsal margin, and three or four obsolete teeth at the post-ventral border. Margin otherwise simple. Posterior muscle-scar long, large, triangular. Crowded concentric, rather irregular accremental striæ, with very fine broken radial incisions.

Dimensions.—Antero-posterior, 2·4 mm.; umbo-ventral, 2 mm.

Locality.—MacDonnell Bay and Guichen Bay, in shell-sand.

Variations.—When dead they become white, the amber colour disappearing first about the umbo, and last about the ventral margin. Some show four obscure rounded radial ridges, from the umbo to the posterior inferior angle; and these may crenulate the margin. Dorsally to these the shell may be somewhat hollowed. The posterior marginal teeth may crenulate the border, as may also the front teeth.

Bathyarca perversidens, Hedley.

Bathyarca perversidens, Hedley, Memoirs of Australian Mus., 1902, vol. iv., part 5, p. 298, fig. 45. Type locality, off Port Kembla, in 63-75 fathoms, etc. Var.—*Bathyarca cybœa*, Hedley, Trans. New Zealand Inst., 1906, vol. xxxviii., 1905, p. 70, pl. 1, figs. 3-4. Type locality, 110 fathoms, east of Great Barrier Island, New Zealand.

Dredged off Cape Jaffa, in 130 fathoms, 2 valves; in 300 fathoms, very many valves.

A series was submitted to Mr. Hedley as *B. cybœa*, and he kindly compared with his types and confirmed the identification. A suggestion was also put forward that his two shells were variants of one species, and he allowed that my series seemed to bridge the interval between the two. Being persuaded they are conspecific, I have named them *B. perversidens*, which has priority, making *B. cybœa* a variant.

In all my specimens the right valves have much more pronounced sculpture than the left, especially the radial. Some shells have the sinuation at the gape quite deep, with the depression from this to the umbo marked, others but slight, and others not at all. Some have quite a distinct angle at middle of the posterior side, where a straight-dorsal half meets the rounded ventral part; in others the posterior side is continuously curved.

It is interesting to note the very wide area of distribution of this small species: over 36 degrees of longitude and in almost identical latitudes.

Philobrya cuboides, *sp. nov.* Pl. xxviii., figs. 5, 6, 7, 8, 9.

Shell minute, solid, subrhomboidal, inflated, equivalve, inequilateral, varying in different specimens. Anterior margin forming rather more than a right angle with the dorsal border, and straight for one-half its length, then sweeping with a large curve into the convex ventral margin. Posterior margin forming a more obtuse angle with the dorsal border, nearly straight throughout its whole length, and joining the ventral margin by a rounded angle. Umbos provided with adherent embryonal scales, which are thick, slightly more than a semicircle, their diameters almost opposed, their centres slightly prominent, the borders of their circumference, but not of their diameters, margined and slightly reflected. Infraumbonal ligamental area narrow and long. Hinge-line wide, of two parts joined at an open obtuse angle where it is narrowest. Cartilage-pit excavated in the ligamental area from the umbonal scale, directed obliquely backwards. Anteriorly to the pit are two stout, erect oblong teeth, directed backwards and inwards. Posteriorly are three stout, erect, nearly oblong teeth, directed almost transversely forwards and inwards.

Sculpture.—The surface has close-set, broad, low, radial ribs, and rather narrower concentric ribs, at about equal distances. The inner margin of the shell is denticulated; not at all, or only slightly on the straight parts.

Dimensions.—Umbo-ventral, 2·75 mm.; antero-posterior, 2·15 mm.: sectional of the closed valves, 1·5 mm.

Locality.—Backstairs Passage, 20 fathoms, 30 alive, many dead: Spencer Gulf, deep water, 13 alive.

Obs.—In life it is covered with a conspicuous thick periostracum, projecting as a hairy fringe along the ribs and beyond the margins. The shell is tinged throughout, or blotched with pinkish-brown.

Variations.—Typically the umbos are subcentral, rather nearer the anterior end of the hinge-line. In some specimens they are much nearer the front, when the cartilage-pit is longer and more oblique, and the whole shell is more oblique. The umbo-ventral diameter may be, in some instances, atypically greater than the antero-posterior. The dorsal border may be atypically short, and the dorso-lateral angles too obtuse, so as to give a circular rather than a quadrate outline to the margin of the shell.

Its exact generic location is somewhat doubtful.

Trigonia margaritacea, Lamarck, *var.* **bednalli**, *var. nov.*

Pl. xxviii., figs. 1, 2, 3.

Trigonia margaritacea, Lamarck, Ann. du Mus., vol. iv., p. 355, pl. lxvii., fig. 2. *T. pectinata*, Lamarck, Anim. S. Vert., 1819, vol. vi., p. 63: Encyc. Meth., 1832, vol. iii., p. 1048.

The shell here referred to was first taken on the South Australian shore, between Glenelg and the Semaphore, by Mr. W. T. Bednall, about the year 1865, and was catalogued by him in a list of South Australian shells, published (for private circulation only) in 1875, and was noticed in his excellent paper on "Australian Trigonias and their Distribution," in Trans. Roy. Soc. S. Austr., vol. i., 1878, p. 79, under the name of *T. margaritacea*, Lamarck. He said:—"Its particular habitats in our waters have not yet been discovered, no live specimens having yet been dredged." In vol. ix., pp. 101-102, Tate recorded it as having been "dredged in life from 8 fathoms in Encounter Bay (R. H. Pulleine)." A few years later, when I had the pleasure of Mr. Bednall's company on one of my earlier dredging excursions. we discovered it in St. Vincent Gulf, and obtained about 70 specimens, living and dead, from 15 to 20 fathoms, in Yankalilla Bay. Dredging since then has revealed a considerable range, both in depth and area, as shown by the following details:—It has been taken alive at 10 fathoms, 2 small examples; 12 fathoms, 7; 14 fathoms, 3; 15 fathoms, 3; 17 fathoms, 15; 19 fathoms, 16; 15 to 20 fathoms, about 50; 22 fathoms, 18. They have been taken as valves from 9 up to 200 fathoms. They have extended from Wallaroo Bay, at 15 fathoms, throughout Spencer Gulf, through Investigator Strait, in St. Vincent Gulf, as far up as Yankalilla Bay, and through Backstairs Passage. Beyond this, as far as Beachport, where I have only tested at depths from 49 to 300 fathoms, none but dead specimens have been obtained; though 1 example, the largest in my cabinet, perfect, and quite recent, and of a white colour, was brought up from 110 fathoms at this most easterly of my stations. Their zone is manifestly from 12 to 23 fathoms, only stragglers occurring at less depths, and dead shells at greater depths.

They are very varied in colour, white, pale yellow, light orange, delicate mauve, pink, "crushed strawberry," and purple.

This variety is characterized by its very compressed shape, its narrow ribs, its large, oblong, plate-like spines, broader at their free than at their attached ends, features which are exceedingly constant in the very large series obtained. *T. lamarckii, var. reticulata*, Ten. Woods, found off the coast of New South Wales, is regarded by Mr. Hedley

as the same species, as is also *T. acuticostata*, McCoy (Memoirs Austr. Mus., iv., part 5, 1902, p. 301).

The late Mr. Dennant kindly compared our South Australian shells with McCoy's fossil form from Victoria, and he thought they were not identical, nor conspecific with *T. reticulata*, Ten. Woods. However, I think it is too closely allied to be regarded as a distinct species, so it has been placed as a variety of *T. margaritacea*, Lamarck.

Among the many hundreds of valves and living specimens dredged by me, only 1 has shown any marked departure from the type of this variety. This was taken alive at 23 fathoms in St. Vincent Gulf, together with 2 others, which quite conformed to the type. This unique individual exactly resembled a half-grown specimen of the common *T. margaritacea*, Lam., obtained from Tasmania. The only other aberrant from our form seen by me is a specimen taken by Mr. Zietz, at Corny Point, Spencer Gulf. It has the spines of *T. margaritacea* and the same number of ribs, but the shape is more that of *T. lamarckii*, found in Port Jackson, only with fewer ribs and fewer spines, and with an even longer and more concave posterior border, in which last character it departs greatly from our South Australian variety. The occurrence of these two marked aberrants among numerous examples of the ordinary form indicates some other explanation for our variety than either locality or depth of water

Modiola penetecta, n. sp. Pl. xxviii., figs. 15, 16, 17, 18.

Shell small, thin, ovate, ventricose. Beaks apposed, inflated, oblique. Post-dorsal line nearly straight, 11 mm.; anterior-dorsal line, 2 mm. Ventral border anteriorly slightly convex for 8 mm.; then rather more convex, and merging into the semicircular posterior end, which, with a more open dorsal sweep, forms a faint rounded angle with the post-dorsal line. A heart-shaped area, 10 mm. by 8 mm., on the united valves anteriorly is bare and glistening and sculptured with very low lamellar accremental striæ. The rest of the shell is very closely invested with a felted periostracum of short hairs, with short, blunt projections on each side. Internal border simple. Horn-coloured, lighter on the umbonal ridge. Internally chestnut-brown in front, and with pinkish-brown concentric bands, most marked, in the dorsal two-thirds, elsewhere a bluish-white.

Length, 21 mm.; breadth, 13 mm.; thickness, 11 mm.

It differs from *M. australis*, Lamarck, in its shorter, rounder, anterior end, its greater proportional breadth, and its rounder posterior end. Its hairs are more numerous and close-set, shorter, and "elk-horn" in shape, instead of simple.

Habitat.—Dredged alive in numbers in mud at 10 fathoms, off Banks Islands, and at 15 fathoms in Wallaroo Bay, Spencer Gulf.

Glycimeris pectinoides, Deshayes. Pl. xxviii., fig. 4.

Pectunculus pectinoides, Deshayes, Cuv., Régn. Anim (Fortin and Masson's illustrated edition), Mollusques, pl. lxxxvii., f. 8. Illustrations Conchyliologiques, Chenu, *Pectunculus,* pl. ii., f. 2: Reeve, Conch. Icon. *Pectunculus,* pl. viii., f. 44. *Pectunculus gealei,* Angas, Proc. Zool. Soc. Lond., 1873, p. 183, pl. xx., f. 5. Type locality, off Port Macquarie, N.S. Wales. Tate, Trans. Roy. Soc. S. Austr., 1891, vol. xiv., part 2, p. 268; *(Glycymeris),* Tate & May, Proc. Linn. Soc. N.S. Wales, 1901, vol. xxvi., part 3, p. 436. *Pectunculus flabellatus,* Ten. Woods, Trans. Roy. Soc. Vict., 1878 (1877), vol. xiv., p. 61, 62. Type locality, Victoria and Tasmania: Tate, Trans. Roy. Soc. S. Austr., 1886, p. 103, No. 134: *(Glycimeris),* Pritchard and Gatliff, Proc. Roy. Soc. Vict., 1904, vol. xvii. (n.s.), part i., p. 243. *Pectunculus orbicularis,* Angas, Proc. Zool. Soc. Lond., 1879, p. 420, pl. xxxv., f. 9. *Pectunculus beddomei,* E. A. Smith. Chall., Zool., 1885, vol. xviii., p. 255, pl. xviii., f. 1, 1b.

Our South Australian shell was first recorded by Tate as *P. flabellatus,* Ten. Woods, in 1886; later as *P. gealei,* Angas, in 1891. The species figured by Chenu as *P. pectinoides,* Deshayes, and described and figured by Reeve as *P. pectenoides,* cannot be distinguished from a half-grown example of our shell. Reeve gives "Bay of Panama" as its locality, and says:—"After receiving from M. Deshayes the example of this species, originally described by him, Mr. Hinds supplied me with finer specimens from the collection of Captain Belcher." The habitat is far distant, but our shells appear conspecific.

It is not a common shell on our beach, but is fairly abundant in deeper water. It has been dredged in Spencer Gulf from Wallaroo Bay to Thorny Passage, in Investigator Strait, in St. Vincent Gulf, and through Backstairs Passage as far as Beachport. It has been taken alive at all depths between 8 and 30 fathoms, but is most numerous about 22 fathoms. Valves have been secured at all depths explored up to 150 fathoms off Beachport in decreasing quantities.

It is a very variable shell. When young it has an orbicular shape, being rather longer than high, and having a long, straight dorsal border. As it grows, it becomes higher than long, and its dorsal border is proportionally much shorter. It generally remains almost symmetrical; rarely it becomes quite decidedly oblique.

It may vary in obesity. One example, 41 mm. high, may be 30 mm. in section; another, 37 mm. high, may be only 20 mm. in section. The latter are of the compressed *P. bed-*

domei form. It is not explained by senility, for in young individuals an equal disparity is seen.

It may attain a height of 50 mm., a length of 51 mm., and a section of 35 mm.

The ribs differ. Generally they are broad and rounded, wider than the interspaces, which are deep and flat, with vertical sides. But sometimes the ribs are low and wide, and touch one another, so as to have no intervening squarely-ploughed furrow. The concentric sculpture usually consists of flattened contiguous plates on the ribs, while in the intercostal spaces there are low, vertical, thin lamellæ. But it may be no more than crowded concentric liræ, both on the costæ and between them.

The "lunular area" referred to by Angas is on the posterior side of the shell, and therefore does not correspond with the lunule of such shells as Chione. It may be very defined, or only slightly marked or absent.

Not a few individuals, after reaching a diameter of 25 mm., cease to grow in superficial area, but increase in sectional diameter, while they actually decrease in their umbo-ventral; so that their margin becomes curiously incurved and their walls very thick, as figured in pl. xxviii., fig. 4.

As to ornament, some shells in life are nearly white without and quite white within; others are of an almost uniform cinnamon-brown. The usual colour is a dirty-greyish or very faint rusty tint, with rather reddish-rusty indistinct blotches, disposed in irregular and broken cencentric lines; but they may have a pure white-ground colour, marked with long radial, dark purple-brown spots, variously disposed in patterns, or scattered, or coalescing into a large area over the ventral part of the posterior half of the shell.

So within, some are quite white; others have a dark-brown line along the pallial margin, and edging each adductor scar; others have the muscle-scars and the greater part of the interior of a dark purple-brown.

The extent to which the muscle-scars, anterior or posterior, are supported by a callosity also differs greatly.

There is every combination of the above-named differences, so that no true varieties can be established; only individual variations are recognized.

Glycimeris sordidus, Tate.

Pectunculus sordidus, Tate, Trans. Roy. Soc. S. Austr., 1891, vol. xiv., p. 264, pl. xi., f. 8. Type locality, St. Vincent Gulf, 9 to 11 fathoms, alive (Verco). I have taken it since in numbers in Hardwicke Bay, in Backstairs Passage, and in Investigator Strait, at all depths from 13 to 22 fathoms.

Professor Tate had only an immature individual from

which to describe his new species, and the figure given is a rather faulty representation of his type. Material obtained since furnishes the following information, and establishes it as a true species.

The dimensions given are:—Antero-posterior, 20 mm.; umbo-ventral, 18; sectional diameter, 10·5. My largest example measures 36 by 37 by 19·5. As it grows it therefore tends to become comparatively shorter antero-posteriorly, and more obese in section. Two individuals, each 32·5 and 33 mm. in the above measurements, have respectively sectional diameters of 20 and 16 mm., demonstrating very great difference in ventricosity.

There is a marked tendency to rest-periods in its growth, producing, at intervals of about 5 millimetres, concentric steps from a half to one millimetre in depth. There are usually four of these in the adult; there may be six. Then they rapidly become closer and less valid, until the senile stage is reached, when the shell increases much in obesity and very little in altitude, and they are reduced to close-set concentric striæ.

The species is appropriately designated "sordidus," for most shells show scarcely any colour markings on their dirty-white surface. But some are irregularly sparsely dotted with reddish-brown, in somewhat zigzag concentric lines, and are ornamented with four broad, curved, dark purple-brown flames, crossing the anterior and posterior marginal areas of the shell.

Thracia myodoroides, E. A. Smith.

Thracia myodoroides, E. A. Smith, Chall. Zool., 1885, vol. xiii., p. 70, pl. vi., f. 6-6b. Type locality, off East Moncœur Island, Bass Strait, in 38 to 40 fathoms: Pritchard & Gatliff, Proc. Roy. Soc. Vict., 1903, vol. xvi (n.s.), part i., p. 104.

This shell was recorded for South Australia by Professor Tate under the name of *Thracia modesta*, Angas, from Tapley Shoal, in Trans. Roy. Soc. S. Austr., 1888, vol. xii., p. 67.

It has been dredged alive at all depths between 8 and 22 fathoms; most abundant at 20 to 22 fathoms. Valves are found at all depths up to 60 fathoms; most numerous between 15 and 22 fathoms. It is fairly abundant, and is distributed from Beachport westward through Spencer and St. Vincent Gulfs.

As the shell grows larger, it changes in shape, becoming proportionally longer antero-posteriorly; thus the type is 13 mm. long by 9·5 mm. high. Other individuals are 16 by 10 and 18 by 11, whereas they should be 11·6 and 13·1 in height respectively.

Thracia concentrica, n. sp. Pl. xxviii., figs. 12, 13, 14.

Shell, rhomboid-oval; anterior-dorsal border straight, scarcely convex; posterior-dorsal border rather more concave; ventral-border uniformly slightly convex, joining the anterior border with a sharp curve; posterior end nearly vertically truncate, scarcely rounded at the superior angle, more at the inferior. A rounded umbonal ridge curves to the posterior inferior angle. Numerous valid, round, rude, incomplete, ill-curved concentric ribs frequently overlap in the median area. Fine crowded, crooked, radial incisions cross the ribs and spaces, and interrupt more crowded concentric incisions, so as to produce a microscopic shagreen pattern. There is a depressed lanceolate dorsal area behind the umbo, at the margin of which the ribs cease, and which is finely antero-posteriorly striate. In the right valve is a very narrow furrow within the dorsal borders for the edge of the left valve, and its inner margin behind the umbo projects as a laminar tooth, soon vanishing posteriorly. The inner surface is glistening, and has faint radial substriations. The pallial sinus is of moderate depth and round.

Dimensions.—Umbo-ventral, 10·8 mm.; antero-posterior, 14·1; sectional, 4·9.

It has not been dredged alive or with united valves, and one cannot be certain about its left valve.

It closely resembles *T. myodoroides*, of Smith, but is more ventricose, has a concave post-dorsal border, and is much more validly concentrically ribbed.

Habitat.—23 fathoms, Backstairs Passage.

Thracia lincolnensis, n. sp. Pl. xxviii., figs. 19, 20, 21.

Shell, thin, white, elongate-oval; anterior-dorsal border nearly straight, scarcely convex; posterior cancave; ventral border almost straight in the posterior half, arcuately ascending in the anterior. Anterior end attenuately rounded, posterior end vertically, straightly truncate; superior and inferior posterior angles rounded. Right valve slightly more convex than the left, which is included all round except at the posterior end. Quite obsolete, flat, irregular concentric ribs, with very faint miscoscopic concentric striæ. The right valve has a groove inside its dorsal margin, except at the umbo, to receive the left valve, and the inner edge of the groove projects to form lamellar teeth, most marked just in front of and behind the subumbonal notch. The pallial sinus is wide and round, and reaches nearly to the centre of the shell. The umbos are acute, incurved, and apposed.

Dimensions.—Antero-posterior, 7·3 mm.; umbo-ventral, 5·1 mm.; sectional, 3 mm.

It somewhat resembles *T. myodoroides*, E. A. Smith, but is smaller, though its proportions are the same. It differs in having a concave instead of a straight post-dorsal line, in not being excavate in front of the umbo, and in having a deeper pallial sinus.

It differs from *T. modesta*, Angas, in being longer posteriorly, and so more equilateral, and in a vertical truncation instead of one sloping upwards and backwards.

Habitat.---Dredged alive at 9, 20, 22, and 24 fathoms, at Port Lincoln, at Yankalilla Bay, and in Backstairs Passage.

Pholadomya arenosa, Hedley.

Thraciopsis arenosa, Hedley, Proc. Linn. Soc. N.S. Wales, 1904, vol. xxix., part i., p. 197, pl. ix., figs. 26-27. Type locality, 100 fathoms, east of Wollongong, N.S. Wales, one valve.

Pholadomya arenosa, Hedley, *op. cit.*, 1906, vol. xxxi., p. 464, Masthead Island, Queensland.

Mr. Hedley has kindly identified my specimens by comparison with his type. Its dimensions were only 4·55 mm. by 2·9 mm; a valve taken in 20 fathoms in Backstairs Passage measures 12 mm. by 7 mm. The typical shape and ornament are retained when adult.

Dredged alive in 5 fathoms, St. Vincent Gulf; dead in Spencer Gulf, Backstairs Passage, and in 62 fathoms northwest of Cape Borda.

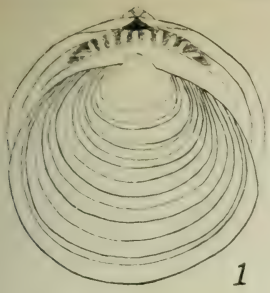
EXPLANATION OF PLATES.

Plate XXVII.

Fig. 1. *Limopsis vixornata*, Verco.
,, 2. *Limopsis eucosmos*, Verco.
,, 3. *Nucula beachportensis*, Verco.
,, 4. 4*a*, 4*b*. *Nuculina (Cyrilla) concentrica*, Verco.
,, 5. *Limopsis tenisoni*, Ten. Woods, var. *penelevis*, Verco.
,, 6. 6*a*, 6*b*, 6*c*, 6*d*. *Sepia braggi*, Verco.
,, 7. *Lissarca rhomboidalis*, Verco.

Plate XXVIII.

Fig. 1, 2, 3. *Trigonia margaritacea*, Lamarck, var. *bednalli*, Verco.
,, 4. *Glycimeris pectinoides*, Deshayes; senile state.
,, 5, 6, 7, 8, 9. *Philobrya cuboides*, Verco, showing exterior, interior, dorsal view, and umbonal scale.
,, 12, 13, 14. *Thracia concentrica*, Verco, showing minute sculpture, side view, and dorsal view.
,, 15. Hair from *Modiola australis*, *Lamarck*.
,, 16. Hair from *Modiola penetecta*, Verco.
,, 17, 18. *Modiola penetecta*, Verco.
,, 19, 20, 21. *Thracia lincolnensis*, Verco, side view, dorsal view, and imaginary umbo-ventral section.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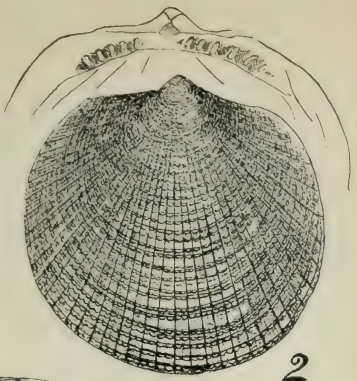
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4a

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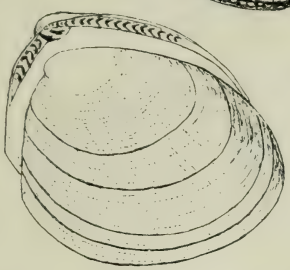
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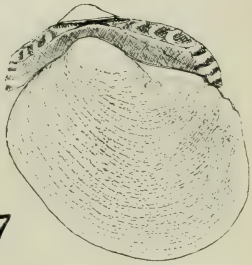
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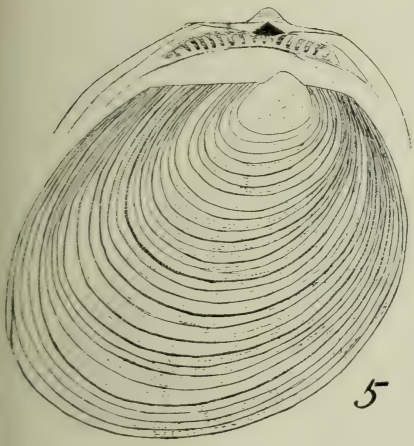
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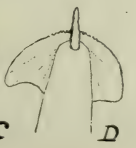
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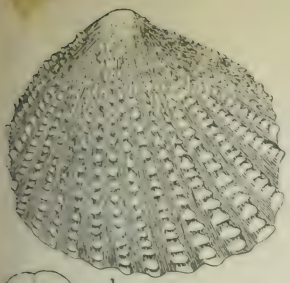
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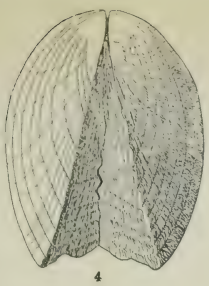
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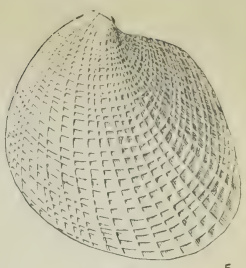
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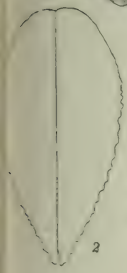
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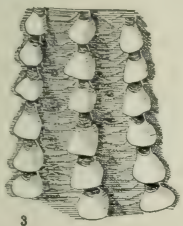
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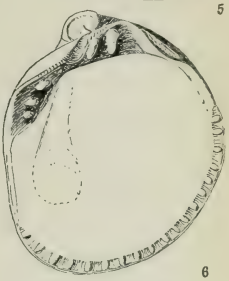
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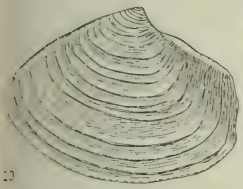
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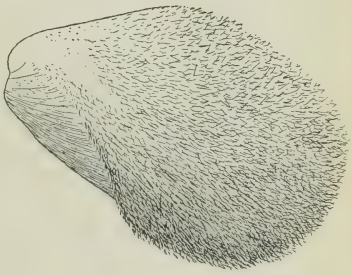
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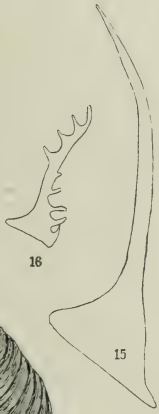
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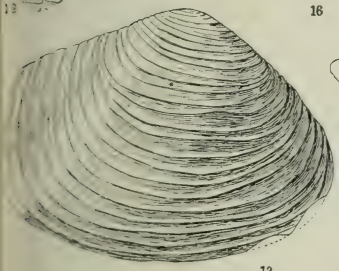
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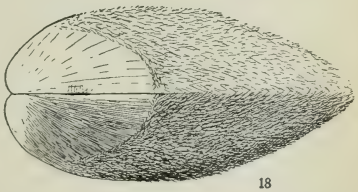
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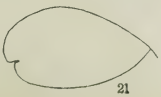
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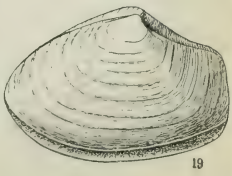
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Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species.

XXXVII.

By the Rev. T. Blackburn, B.A.

[Read October 1, 1907.]

HYDROPHYLLIDÆ.

Cercyon.

I attribute the following species to *Cercyon* with no little doubt whether it ought not to be treated as the type of a new allied genus. But as its distinctive structural characters may perhaps be regarded as simply modifications of the *Cercyon* type, I have ventured to include it provisionally in *Cercyon*. Its tarsi are shorter and stouter than in any other *Cercyon* known to me, but notably longer than those of *Megasternum;* the basal joint of the hind tarsi only very slightly longer than the 2nd joint. The 3rd joint of the maxillary palpi is much shorter than the 4th. The middle part of the metasternum is an abruptly-elevated flat and brilliantly nitid area of obcordate shape, the rest of the segment opaque owing to the presence of very fine confluent sculpture. The mesosternal keel is long and well defined, but very narrow; linear in fact. The prosternal keel is normal. The elytra are without any trace of striation. I do not find any other distinctive character likely to be generic.

C. kingense, sp. nov. Ovale; nitidum; piceo-nigrum, antennis (clava excepta) palpis pedibusque rufis, corpore subtus et elytris apicem versus plus minusve rufescentibus; exemplorum nonnullorum prothorace rufescenti; capite pronotoque crebre (hujus lateribus magis sparsim) subtiliter punctulatis; elytris haud striatis, subcoriaceis et puncturis subtilissimis sed perspicuis sat crebre impressis; prothorace fortiter transverso, antice parum angustato, lateribus leviter arcuatis, angulis omnibus obtusis; carina mesosterni perangusta sat elongata, prosterni sat elevata; tarsis sat brevibus sat robustis, articulo basali quam 2us parum longiori. Long., 1-1½ l.; lat., ½ l. (vix.).

Under a microscope the coriaceous appearance of the elytra is seen to be caused by a reticulation of sharply-defined scratches.

King Island (Mr. A. M. Lea).

CRYPTOPHAGUS.

C. tasmanicus, sp. nov. Elongatus; parallelus; modice convexus; pubescens; totus ferrugineus; antennis sat robustis, articulis 9° 10° que fortiter transversis (hoc quam ille nonnihil longiori nonnihil latiori); capite pronotoque crebre subtilius punctulatis; hoc leviter transverso, ante scutellum plus minusve gibbo, utrinque ad angulum anticum tuberculum sat magnum ferenti, lateribus parum arcuatis haud dentatis, angulis posticis sat rectis; elytris crebre subtilius punctulatis, circa scutellum sat fortiter gibbis.

Maris tarsis heteromeris, anticis sat dilatatis; feminæ tarsis pentameris simplicibus. Long., 1 l.; lat., $\frac{1}{4}$ l.

Resembles *C. gibbipennis*, Blackb., in the gibbosity of the elytra around the scutellum, but differs from it, *inter alia*, by the presence of a conspicuous tubercle immediately within the anterior angles of the pronotum, and by the much finer and closer puncturation of the elytra.

Tasmania (Mr. A. M. Lea).

MYRABOLIA.

M. longicornis, Blackb. Two specimens from Tasmania sent by Mr. Lea differ from the type in their very small size (scarcely exceeding 1 l. in length), and by the anterior sinuation of the sides of the pronotum being scarcely traceable. It is possible that they represent a distinct species.

M. parva, Blackb. A Tasmanian example of *Myrabolia*, sent by Mr. Lea, is of distinctly narrower build than the type, and its prothorax is a little more strongly transverse. These differences are, perhaps, sexual.

TROGODERMA.

T. rigua, Er. Among the King Island *Coleoptera* lately taken by Mr. A. M. Lea are two specimens of a *Trogoderma*, which in all probability represent this species. They agree very well with Erickson's description in every respect except the pilose markings of the elytra, and are evidently abraded. *Rigua* is described as having four fasciæ and an apical spot formed of white pilosity on its elytra. In one of the examples before me there is a subbasal white fascia, exactly as described, and obscure traces of white pilosity in other parts, which may well be the remains of fasciæ. In the other example there is scarcely any trace of fasciæ, but there are some white hairs close to the apex, which are likely to be the remains of a white spot. I am fairly confident in making this identification because *T. rigua* is described as presenting some characters unusual among the Australian *Trogodermata* which are

well marked in this insect, especially that of the large three-jointed antennal club and the very close puncturation of the pronotum. I have seen no *Trogoderma* but this one having antennæ agreeing with Erickson's description. In my tabulation of the Australian species of *Trogoderma* (Trans. Roy. Soc., S.A., 1903, p. 162) this species would stand beside *T. Adelaidæ*, Blackb., from which it differs, *inter alia*, by the club of its antennæ three-jointed (at any rate in one sex), and the puncturation of its pronotum much closer still than in *Adelaidæ* (entirely confluent, in fact). In a former Memoir (Tr.R.S.S.A., 1891, p. 130) I formed a new genus, *Adelaidea*, for a South Australian *Dermestid* widely separated from *Trogoderma* generically but agreeing so well as a species with the description of *T. rigua* that I expressed a doubt as to whether it might not be possible that it was the species on which Erickson's description was founded. The study of these King Island specimens is conclusive against that conjecture.

LAMELLICORNES.

COPRIDES.

Onthophagus.

O. ocelliger, Har. I have received from Mr. French several specimens (both sexes) taken in the far north of Western Australia which I refer to this species. They agree well with the description, but two of them depart from it in having their eyltra more or less spotted with red. They are extremely close to *O. asper*, Macl., but differ from it in being a trifle smaller; with the pronotum somewhat more nitid, not quite so closely punctulate, devoid of the small tubercle that occupies the middle of the front margin in (at least one sex of) *asper*, and having its base distinctly margined in the middle. The sexes do not differ much *inter se;* the front tibiæ of that which I take to be the male are a little longer and more slender, and the pygidium of the same a little more convex than in the other sex. The presence of a distinct fine line margining the middle part of the base of the pronotum places this species (in my tabulation of *Onthophagus*, Tr. Roy. Soc., S.A., 1903, pp. 267, etc.) in Group V., where it falls beside *O. henleyensis*, Blackb., from which, however, its pilosity, closer puncturation of pronotum, unequal elytral interstices, and very much smaller size, separate it widely.

O. carmodensis, sp. nov. Sat latus; supra glaber; subtus pilosus; modice nitidus; niger, antennarum clava flava, tarsis rufescentibus; clypeo antice fortiter emarginato; capite æquali, antice ruguloso, postice fere lævi; oculis sat latis lævibus; prothorace quam longiori ut 19 ad 11

latiori, supra obsolete (vix perspicue) punctulato, supra æquali (foveis sublateralibus exceptis), lateribus ante medium haud (pone medium fortiter) sinuatis, angulis anticis fere rectis subproductis postis obtusis bene definitis, basi tota subfortiter elevato-marginata; elytris nitide minus subtiliter crenulato-striatis, interstitiis leviter convexis coriaceis vix manifeste punctulatis; pygidio sparsim minus subtiliter (metasterno ad disci latera sat fortiter) punctulato; unguiculis sat magnis ut *O. Kingi*, Har., ad basin abrupte curvatis. Long., $4\frac{1}{2}$ l.; lat. $2\frac{4}{5}$ l.

The presence of a distinct raised edging along the base of the pronotum places this species in Group V. in my tabulation of *Onthophagus (loc. cit.)*, where it falls beside *O. Helmsi*, Blackb., and *O. Koebelei*, Blackb., from both of which it is distinguished by its very much larger size and *inter alia* by the absence of distinct punctures on its pronotum. The adoption of the sculpture of the base of the pronotum as the character on which to found primary divisions of *Onthophagus*, although the most satisfactory that I can find, undoubtedly divides into separate groups some species that seem more suited from their general appearance to be placed near each other, and the present insect furnishes a case in point, as the species to which it bears most resemblance are in Groups IV. and VI., especially *Kingi*, Har., *parvus*, Blanch., *Murchisoni*, Blackb., *submuticus*, Blackb., *inermis*, Macl., and *muticus*, Macl., from all of which, except *Murchisoni*, it is at once separated by the emarginate apex of its clypeus; while from *Murchisoni*, besides the character already mentioned, it differs, *inter alia*, by the structure of its hind claws. I am doubtful of the sex of the type of this insect, but consider it to be probably a female, as its front tibiæ are only moderately slender and the teeth of their external margin are extremely long and stout.

North-Western Australia (from Mr. French); Carmod Bay.

SYSTELLOPIDES.

I have recently received two species appertaining to this subfamily, of which one agrees with the diagnosis of the genus *Trichelasmus*, the other with that of *Enamillus*. The distinctness, *inter se*, of those two genera is based upon the number of joints in the antennal flabellum,—a character that seems to me of no value at all from a generic point of view,—and I am convinced that they ought to be regarded as representing only one genus. As, however, I have not seen either of the species for which the names were proposed it would be unwise actually to suppress either name at present and there-

fore I shall provisionally use both Dr. Sharp's names for the species before me. Dr. Sharp says that his *T. pilicollis* and *E. striatus* are excessively like each other; a similar statement may justifiably be made regarding the two species I am about to describe. The question arises whether it may be that *Trichelasmus* is the female of *Enamillus;* but I think it must be answered in the negative, although certainly it seems a suspicious circumstance that each genus should contain two species, not very like each other superficially, but each extremely like one in the other genus. The objection to regarding the difference between these two aggregates as sexual are as follows (at any rate in respect of the two forms before me):—*(a)* In no species known to me of the Australian *Melolonthides* is there, strictly speaking, a difference between the number of joints in the antennal flabellum of the male and the female; where such a difference has been recorded it has been founded on the fact of the basal joint or joints of the flabellum in the female being so slightly prolonged as to have been (incorrectly) excluded from the flabellum, whereas of the species before me one has basal three and the other only basal two joints devoid of any inner prolongation whatever; *(b)* in one of the forms before me the antepenultimate joint of the maxillary palpi is considerably longer than the penultimate; while in the other the corresponding joints are of equal length; *(c)* the striation of the elytra is notably different in the two forms; *(d)* in the specimen before me which is evidently Sharp's *Trichelasmus* the ventral segments are of the male type (shorter and more crowded together, with the apex of the pygidium slightly inclined towards the ventral segments) but its antennal flabellum is of the female type (if the two were considered to be sexes of one species), whereas in the specimen that is Sharp's *Enamillus* the ventral segments (on the supposition of the two forms being sexes of one species) would point to its being the female and the antennal structure to its being the male; *(e)* having before me two specimens of the *Trichelasmus* form, I find that in one of the specimens there is a large, circular, deep fovea in the centre of the pygidium which may possibly be accidental, but which on the other hand not improbably indicates that I have both sexes of *Trichelasmus* before me.

ENAMILLUS.

E. Mauricei, sp. nov. Piceo-niger, pruinosus, antennarum stipite ferrugineo, elytrorum partibus 2 basalibus læte rufis; corpore subtus fronte pronoto scutelloque longe fulvo-pilosis; labro subnitido lævi leviter transverso, quam clypeus vix angustiori; clypeo subnitido crebre subtilius

ruguloso; fronte opaca obsolete rugulosa; palporum maxillarium articulo antepenultimo quam penultimus sat longiori; antennis 9-articulatis, articulo 3° intus angulato, flabello magno 6-articulato arcuato articulis intus confertim breviter pilosis (articulis apicali basalique subtus circum ceteros intortis); prothorace opaco quam longiori duplo latiori, antice leviter angustato, supra obsolete vix crebre punctulato, lateribus sat arcuatis, angulis omnibus rotundatis, basi utrinque sat fortiter sinuata; scutello permagno, ut pronotum punctulato; elytris opacis perspicue nec fortiter 9-striatis, striis punctulatis geminatim ordinatis, interstitiis sparsim obsolete punctulatis sat planis; pygidio nitido sparsim subtilius punctulato; tibiis articis extus fortiter bidentatis, posticis brevibus valde incrassatis; tarsis posticis sat robustis modice elongatis, articulo basali quam 2us paullo longiori; coxis posticis quam metasternum sat brevioribus; segmento ventrali apicali postice haud emarginato. Long. 7 l.; lat. $3\frac{2}{5}$ l.

The description of *E. striatus*, Shp., is so brief that it is not practicable to specify the distinctions between it and the present insect further than by mentioning that the larger size of *E. Mauricei* and the red colouring of the basal two-thirds of its elytra no doubt sufficiently distinguish it. I have called the front area (of the three areas into which the head is divided) the "labrum," although I am doubtful whether that area is really a true labrum. Dr. Sharp calls it the labrum, while Lacordaire considers it a part of the clypeus. The sculpture of the front tibiæ (which have only a single external tooth above the apical projection) is not usual in the Australian *Melolonthides*. The Systellopides form a most interesting and isolated group of *Lamellicornes*.

Central Australia (Musgrave Ranges). Taken by the explorer, R. P. Maurice. Type in S.A. Museum.

TRICHELASMUS.

T. basalis, sp. nov. Piceo-niger, pruinosus, antennarum stipite labro palpis elytrorum macula magna basali pedibusque læte rufis; corpore subtus fronte pronoto scutelloque longe fulvo-pilosis; labro nitido, fere lævi, quam longiori plus quam duplo latiori, quam clypeus haud angustiori; clypeo sat nitido crebre minus subtiliter ruguloso; fronte opaciori quam clypeus vix aliter rugulosa; palporum maxillarium articulis penultimo antepenultimoque longitudine sat æqualibus; antennis 9-articulatis, articulo 3° intus haud angulato, flabello sat magno 5-articulato arcuato articulis intus confertim breviter pilo-

sis (articulis apicali basalique subtus circum ceteros intortis); prothorace opaco quam longiori fere duplo latiori, antice sat fortiter angustato, supra acervatim leviter punctulato, lateribus sat arcuatis, angulis anticis bene definitis sat rectis posticis subrotundatis, basi utrinque sat fortiter sinuata; scutello magno opaco leviter vix crebre punctulato; elytris opacis 4-striatis, parte dimidia laterali haud perspicue striata, striis nonnihill geminatim ordinatis, interstitiis planis confertim subtilissime subasperis; pygidio pernitido sparsim leviter punctulato; tibiis anticis extus fortiter bidentatis posticis brevibus sat fortiter incrassatis; tarsis posticis modicis, articulo basali quam 2us sat longiori; coxis posticis quam metasternum sat brevioribus; segmento ventrali apicali postice haud emarginato. Long., 6 l.; lat., $3\frac{1}{5}$ l.

The description of *T. pilicollis*, Shp., is brief and does not mention many characters available for comparison with the present insect. The large red basal spot (occupying about a third part of the area of the elytron) on each of the elytra of *T. basalis* is, however, no doubt a distinctive character; and Sharp's statement that the labrum of his species is "very large" clearly indicates specific difference. I am disposed to think that I have both sexes of this species before me, not only because the large round forea on the pygidium of one of them seems not unlikely to be sexual, but also because the hind tarsi, in the specimen having the foveate pygidium, are distinctly (though not very much) more robust than in the other specimen.

Western Australia: Esperance Bay (Mr. French).

SAROTHROMERUS *(gen. nov., Systellopidarum).*

Mentum leviter transversum antice rotundatum; palpi labiales breves, ad basin haud contigui, articulo apicali subconico; palpi maxillares robusti modice elongati, articulo 2° quam 3us sat longiori quam 4us sat breviori; labrum (? clypei pars antica) quam clypeus (? quam clypei pars postica) fere duplo angustius; oculi reniformes; sutura inter frontem clypeumque haud carinata; antennæ 9-articulati, flabello 6-articulato, flabelli laminis (? maris solum) gracilibus intus setis robustis plurimis elongatis (his subtiliter pilosis) fimbriatis; prothorax fortiter transversus; scutellum permagnum transversum; elytra geminato-striata; corpus supra glabrum, subtus pilosum; coxæ posticæ quam metasternum haud breviora.

Type.—*Enamillus Sharpi*, Blackb.

When I attributed this insect to *Enamillus* (Tr.R.S.S.A., 1905, p. 278) I had not seen a typical member of that genus,

and therefore mentioned the probability that a new generic name might be required eventually. Having now examined a genuine *Enamillus* I find that my forecast was correct, as will appear from the above diagnosis. The antennæ of this insect (perhaps of the male only) are truly remarkable, and might fitly be characterized as an exaggeration of the antennæ of *Diphyllocera*. Each lamina of the flabellum is fringed with a row of robust elongate filaments or setæ, and each of these filaments is itself clothed with fine erect pilosity. The first lamina is so shaped as to somewhat enfold some of the following laminæ, which was my chief reason for placing the species in *Enamillus* provisionally; but having now examined a true *Enamillus* I am able to say that the enfolding in the present genus is much slighter than in *Enamillus*.

SERICIDES.

ATERMONOCHEILA *(gen. nov., Sericidarum)*.

Mentum sat transversum, antice emarginatum; palpi labiales modici, articulo apicali elongato gracili subfiliformi; palpi maxillares sat elongatis sat gracilibus, articulo apicali subcylindrico; labrum haud manifestum; oculi magni minus nitidi subtilissime granulati, antice a cantho profunde incisi; antennæ (speciei typicæ) 9-articulatæ, flabello 3-articulato (laminis maris quam articuli ceteri conjuncti vix brevioribus, pilis brevibus subtilibus erectis vestitis); clypeus antice truncatus; prothorax transversus; elytrorum interstitia alterna angusta lævia, alterna lata haud lævia; pedes graciles; tibiæ anticæ (speciei typicæ) extus bidentatæ, dente tertio supra medium vix manifesto; corpus totum setis brevibus crassis adpressis vestitum; coxæ posticæ perbreves, quam metasternum fere triplo breviores.

This genus must be placed near *Epholcis*, from which it differs by, *inter alia*, its flat transverse mentum, the structure of its labial palpi, its much more elongate legs (with claws elongate, slender, and devoid of quill-like appendages), and its elytra geminate-substriate, after the manner of *Scitala*. A hind tibia with its tarsus is considerably longer than the elytra. It should be added that the term "geminate-substriate" requires qualification in respect of the elytra of the typical species of this genus. The subsutural stria is very distinct, but the alternate interstices on the remaining part of the elytra, while narrow and devoid of sculpture (as in *Scitala*), are not limited by defined striæ. If additional species of this genus are discovered, it is probable that the elytral interstices will be found to be alternately wide with sculpture and narrow without sculpture. But the character of the striation in other respects is probably not generic.

A. longipes, sp. nov., Mas. Ovata; sat nitida; tota setis brevissimis adpressis sat æqualiter minus crebre vestita; opaca; rufo-ferruginea, pedibus rubris; clypeo antice sat reflexo; prothorace quam longiori ut 9 ad $5\frac{1}{2}$ latiori, antice minus angustato, lateribus modice arcuatis, angulis anticis vix acutis parum productis posticis subrotundatis, basi haud marginata utrinque sat fortiter sinuata; scutello sat elongato triangulari; elytris stria subsuturali impressis, interstitiis 4 lævibus ornatis; tarsorum posticorum articulo basali quam 2us sat breviori; segmento ventrali apicali perbrevi, postice haud emarginato. Long., 5 l.; lat. $2\frac{3}{5}$ l.

This being the typical species of the genus, it is unnecessary to repeat, in describing it, the characters already cited in the generic diagnosis. With the exception of the subsutural stria of the elytra the whole dorsal and under-surface of the body is devoid of sculpture other than the remarkably evenly-distributed punctures, in which the setæ are inserted, and which are only visible when the setæ have been removed. The setæ are extremely short, closely adpressed, and somewhat coarse.

Western Australia. Given to me by Mr. Jung.

SERICOIDES.

Caulobius.

C. (Ocnodus) ferrugineus, Blackb. (Tr.R.S.S.A., vol. xvi., p. 28). This species, attributed by me with an expression of much doubt to *Ocnodus*, must be transferred to *Caulobius*. In my tabulation of distinctive characters of the species of *Caulobius* (*loc. cit.*, 1906, p. 288), *C. ferrugineus* falls beside *C. punctulatus*, Blackb., from which it may be distinguished as follows: —

D. Elytral interstices quite strongly convex ... ... punctulatus, *Blackb.*
DD. Elytral interstices not convex ... ferrugineus, *Blackb.*

As the type of this species is unique and belongs to the S.A. Museum, I have not been able to subject it to the manipulation necessary to arrive at certainty as to the number of joints in its antennæ; I am, however, almost sure that they are nine in number.

Haplonycha.

H. Griffithi, sp. nov., Fem. Sat elongata; ovata; subnitida; rufa, elytris antennis palpisque testaceo-brunneis; leviter iridescens; corpore subtus pedibusque longe pilosis; palporum maxillarium articulo 3° quam 2us et quam 4us sat breviori; antennis 9-articulatis, articulo 4° quam 3us

sat breviori; flabello 5-laminato, lamella basali perbrevi ceteris quam articuli 2-5 conjuncti vix brevioribus; clypeo modice elongato, peralte reflexo, subtiliter sat sparsim punctulato; fronte subtiliter obsolete punctulata; prothorace quam longiori duplo latiori, antice modice angustato, supra sparsim subtiliter sat obsolete punctulato, lateribus sat fortiter rotundatis anguste marginatis, basi utrinque parum sinuata, angulis posticis obtusis bene determinatis; elytris leviter geminato-striatis, sparsim sat subtiliter punctulatis; pygidio sparsim obsolete punctulato, longitudinaliter subcarinato: tarsorum posticorum articulo basali 2° longitudine sat æquali. Long., 9 l.; lat., 4½ l.

This species is readily distinguishable from the other described species of the genus. Its group characters place it in Group V., in which only two iridescent species have been previously described (*gigantea*, Burm., and *lucifera*, Blackb.), from both of which it differs by, *inter alia*, its very much smaller size, the female antennæ terminating in four equal (or nearly so) lamellæ, the forehead scarcely visibly punctulate, etc. It does not fit into my tabulation of *Haplonycha* (Tr.R.S.S.A., 1906, pp. 297, etc.), owing to my having used the word "large" in characterizing the aggregate "A" on p. 301. In order to place it, the following must be substituted for the first nine lines under Group V.:—

A. Iridescent species. [Joint 3 of maxillary palpi conspicuously shorter than joint 2].	
B. Frons conspicuously punctulate.	
C. Pygidium but little nitid, closely sculptured, especially near base	gigantea, *Burm.*(?)
CC. Pygidium brilliantly nitid, its puncturation extremely sparse	lucifera, *Blackb.*
BB. Frons scarcely punctulate ...	Griffithi, *Blackb.*
AA. Non-iridescent species.	

Northern Territory; Port Darwin. Given to me by Mr. H. Griffith.

Petinopus.

I have no further information to be recorded regarding this genus, and have not seen any more examples than those mentioned when I characterized the genus in 1898. The unique species is probably a very rare one.

Glossocheilifer.

Since I described *G. labialis* (Tr.R.S.S.A., 1898, p. 37) I have obtained a male example of a second species of this curious genus, of which the following is a description:—

G. addendus, sp. nov., Mas. Elongato-ovatus; subnitidus; supra fere glaber, corpore subtus pedibusque pilosis; rufo-testaceus, elytris dilutioribus; capite confertim subtilius, pronoto sat crebre sat æqualiter subtiliter, elytris subfortiter sat crebre, pygidio sparsim sat obsolete punctulatis; clypeo antice rotundato minus fortiter reflexo; prothorace postice marginato, antice angustato, sat transverso, lateribus fortiter arcuatis, angulis anticis parum productis subobtusis posticis rotundatis, basi utrinque subsinuata; elytris in disco sat (latera versus vix) manifeste striatis, striis geminatis; tarsorum posticorum articulo basali quam 2us sat breviori. Long., 7½ l.; lat., 3⅘ l.

Australia; exact locality doubtful, probably Western Australia.

Apart from colour, this species differs from *G. labialis*, Blackb., by, *inter alia*, the closer discal puncturation of its pronotum, the blunter and less prominent front angles of its prothorax, and the notably stronger and closer puncturation of its elytra. The joints of the flabellum of its antennæ are not quite so long as the preceding joints of the antennæ together. The hind coxæ are very evidently, but not very much, shorter than the metasternum; in *G. labialis* they are a little shorter than in this species.

Scitala.

The positive identification of species described by the older authors in this genus is practically impossible without examination of types which are scattered through European collections, and some of which have probably perished. There is no other alternative than either to leave the genus as constituting an insoluble enigma or to deal with it, using one's best judgment in making probable identifications, and produce a monograph of its species, which is sure to contain many errors, but which will at any rate, I hope, prove to be intelligible and, therefore, capable of correction. At present there is comparatively little which can be affirmed either to be correct or to be incorrect, as a large number of the descriptions of species are incapable of identification with any insect in particular, and therefore I adopt the latter of the expedients mentioned above. If I can, with the aid of some knowledge of localities in which species occur, arrive at the probability of the insects on which the descriptions were founded and claim some at least of the old names for species which my notes may render identifiable, it will be possible for workers who may have access to such of the widely-scattered types as still remain to confirm or correct my identifications.

It is extremely difficult to compile a satisfactory list of the names that can correctly be said to have been applied to insects that have been or at the time of description might have been with fairly good reason regarded as members of this genus. I have already discussed at some length (P.L.S.N.S.W., 1890, pp. 539, etc., and Tr.R.S.S.A., 1898, pp. 37, etc.) the highly intricate question of the generic validity of the names *Scitala* and *Sericesthis*, and I will not now repeat the discussion but merely mention the conclusion I arrived at and to which I still adhere, viz., that they are both valid names, *geminata*, Boisd. (which is the type of *Sericesthis*, and is generally accepted as a later name for *Melolontha pruinosa*, Dalm.) being generically distinct from the species for which Erickson founded the genus *Scitala*. Other species to which other generic names (*Melolontha*, *Cotidia*, and *Anodontonyx*) have been applied by their authors have been by some authors attributed to *Scitala*. As indicated below, *Cotidia* is probably synonymic with *Heteronyx*. *Anodontonyx* may rightly be treated as a valid genus. Of course none of the species in question are true members of the genus *Melolontha*. The name *Scitala*, then, must, in my judgment, be restricted (among the Australian *Sericoides*) to species possessing the following characters: Prosternal sutures normal, claws simple, membranous wings fully developed, femora not exceptionally elongate and slender, elytra normally elongate, eyes large convex and scarcely granulate, front tibiæ and antennal flabellum not of extraordinary structure, tarsi not bearing tufts of long soft hairs, labrum distinct from the vertical front face of the clypeus,[1] front of clypeus neither emarginate nor with acute lateral angles, base of pronotum completely margined, elytra geminate-striate, hind tibiæ fairly elongate and not very strongly dilated at apex, sterna more or less subglabrous (never closely pilose), flabellum of antennæ not in both sexes very (and subequally) short. The genus *Scitala* is in the extraordinary position of having been founded by Erickson for two species neither of which agrees in all respects with the generic diagnosis. I see no escape from this conclusion, since it appears impossible to doubt that two common Tasmanian insects which agree perfectly as species with the well-expressed descriptions of their author are really the two for which he proposed the name *Scitala*. Moreover, I had the opportunity some years ago of examining specimens which Professor Kolbe of Berlin lent me for inspection as the types of Erickson's species, and I found them to be identical with the species to which I had attributed the names. Erickson says that the

(1) *Scitala pallidula*, Macl., presents the only exception known to me in respect of this character.

antennæ of *Scitala* are eight-jointed and that the flabellum of the male antennæ is more than twice as long as that of the female antennæ. As a fact, the antennæ of *S. sericans* differ from the above description in being nine-jointed, and those of *S. languida* in the flabellum being subequal in the two sexes. I can only suppose that Erickson had of *languida* only the female before him and counted the joints in its antennæ and assumed that the unseen male would differ from its female as male *sericans* differs from its female; and that he then assumed (without counting) that the antennæ of *sericans* had the same number of antennal joints as the species which he regarded as congeneric with it. As *sericans* stands before *languida* in Erickson's memoir—and as the variation of its antennæ from the generic diagnosis is only in respect of a character (*i.e.*, number of joints) which is certainly not generic in the Australian *Sericoides* while the variation of *languida* is in respect of a much more important character (*i.e.*, the sexual structure)—the right course appears to be to amend Erickson's diagnosis by taking out from it "8-articulatæ," and then regard *sericans* as the typical species. Burmeister, indeed, has already altered the generic diagnosis to make it include species with nine-jointed antennæ but without noticing that the antennæ of *sericans* are nine-jointed.

Erickson's generic diagnosis, moreover, is incorrect in its statement that the basal joint of the hind tarsi is shorter than the second joint. This is true of *languida* (more decidedly in the female than in the male), but in the male of *sericans* the basal joint is notably longer than the second. Burmeister reproduces this error in respect of the species (evidently having seen only females), but does not treat it as a generic character. Neither of those authors seems to have observed that the length of the basal joint of the hind tarsi varies sexually. Burmeister indicates that he has not seen the male of *languida*, but nevertheless asserts (probably quoting from Erickson) that the flabellum of its antennæ is very elongate. As a fact it is (as stated above) very short, and the species must be transferred to the genus *Anodontonyx*. There is no definite assertion on the part of either author that he has seen the male of *languida*.

The number of names that have been applied to species under the name *Scitala* or under names that may reasonably be (or at any rate have been) considered equivalent to *Scitala* as that name has been at some time or other understood, is twenty-nine. As I consider that only nine of those names can stand as representing valid species (capable of identification) of the genus *Scitala* in the strict sense, it seems necessary to furnish notes on the names that I reject, as follows:—

Scitala œnescens, Burm. There is nothing in the description of this species that indicates distinction from a darkly-coloured specimen of *S. sericans*, Er., which varies extremely in colouring.

Scitala armaticeps, Macl. I have examined the type of this insect in the Australian museum and find that it is a *Neso*, and differs from all the other described species of that genus by, *inter alia*, the remarkable elevated transverse carina that crosses its clypeus a little in front of the clypeal suture.

Cotidia australis, Boisd. This name stands in Masters' Catalogue as a synonym of *Sericesthis (Scitala) pruinosa*, Dalm., but that reference is certainly incorrect, as Boisduval says, "subtus pilis fulvis hirsuta." There is in the Macleay Museum a specimen ticketed in Mr. W. S. Macleay's writing, "Cotidia australis, Gory"—the name followed by an obscure mark (in very much-faded ink) which I think has been a note of interrogation. Unless the actual type can be referred to, this Sydney specimen is probably the most authentic in existence, and it seems to agree fairly with Boisduval's pseudo-description. It is a *Heteronyx*, and therefore need not be further discussed here.

Melolontha chlorotica, Gyll. A label in the handwriting of Mr. W. S. Macleay, bearing the words "Ectoma chlorotica, Sch.," is attached to a specimen in the Macleay Museum. Probably this specimen is a co-type, if not the actual type. As it is a *Heteronyx* I need not discuss it further here.

Sericesthis geminata, Boisd. Described in six words. Burmeister makes it identical with *Sericesthis pruinosa*, Dalm., which is not a true *Scitala*. No guess, even at its genus, can be made from the description.

Melolontha ciliata, Boisd. Referred by Burmeister and Blanchard to *Haplonycha*, and reported by me under heading of that genus as incapable of identification. The Macleay Museum possesses a specimen ticketed in Mr. W. S. Macleay's writing "Sericesthis ciliata, McLeay." It is almost certainly a co-type. Being a *Heteronyx* its further discussion will stand over to the next paper of this series.

Sericesthis glabra, Blanch. Probably *Scitala* or *Anodontonyx*, but the description does not mention the structure of the antennæ, and such as it is would apply to several species of either genus.

Scitala impressa, Brenske. This is probably a later name for *Neso (Scitala) armaticeps*, Macl. The type of *armaticeps* agrees well with Brenske's description.

Scitala languida, Er. = *Anodontonyx*.

Sericesthis micans, Blackb. = *Anodontonyx*.

Sericesthis nigrolineata, Boisd. = *Anodontonyx*.

Scitala pallidula, Macl. I have examined the type specimen in the Macleay Museum. Unfortunately there is no means of determining its sex. It seems to be a typical *Scitala* (the unusual shape of the clypeus being disregarded) if it be a female; but if it is a male the short laminæ (three in number) of the antennal flabellum, together with the peculiar clypeus may justify Macleay's suggestion that it "should perhaps form a new genus." Its place in my tabulation *(infra)* indicates its principal characters. The exceptional shape of its clypeus makes it stand in *Byrrhomorpha* in my tabulation of *Sericoid* genera (Tr.R.S.S.A., 1898, pp. 32, etc.). *Vide infra*, under heading *Byrrhomorpha*.

Sericesthis parvipes, Blackb. = *Anodontonyx*.

Sericesthis planiceps, Blackb. = *Anodontonyx*.

Sericesthis pruinosa, Dalm. The type of *Sericesthis*, as distinguished from *Scitala*.

Sericesthis pruinosa, Blanch. *Nom præocc.* = *Scitala rugosula*, Har.

Scitala pruinosella, Brenske = *Sericesthis*.

Sericesthis pullata, Boisd. Described in seven words. Quite unrecognizable. "*Elytris subtomentosis*" seems inconsistent with its being a true *Scitala*.

Scitala rugosula, Har. = *Anodontonyx*.

Scitala suturalis, Macl. = *Sericesthis*, as distinct from *Scitala*. I have examined the type.

Sericesthis cervina, Boisd. In the Macleay Museum is a specimen bearing a label on which Mr. W. S. Macleay wrote "Sericesthis cervina, Dej. N.S.W." As it is probable that the specimen is a co-type, and as it agrees with Boisduval's pseudo-description, there can be little doubt that it is the genuine thing. In former memoirs I have expressed the opinion that *S. cervina*, Boisd. could not be determined without inspection of the type. As the specimen in the Macleay Museum is a *Heteronyx* I need not discuss it further here, but shall hope to do so in the next of this series of papers.

To the nine species which I regard as at present constituting the genus *Scitala* I have now to add ten new species. The following is a tabular statement of the characters by which the species of *Scitala* can be distinguished *inter se*.

A. Antennæ consisting of only 8 joints.
  B. Hind angles of pronotum conspicuously explanate and upturned ... rugosiceps, *Blanch.(?)*
  BB. Hind angles of pronotum not as "B."
    C. Forehead non-rugulose and not nearly confluently punctured.
      D. Pronotum extremely convex longitudinally *(i.e.*, viewed from the side) ... ... convexicollis, *Blackb.*

DD. Pronotum normal.
E. Dorsal surface non-iridescent — parallela, *Blackb.*
EE. Dorsal surface iridescent.
F. Pygidium less finely punctulate (almost as *S. sericans*, Er.) ... ... — Ino, *Blackb.*
FF. Pygidium notably more finely punctulate ... — nemoralis, *Blackb.*
CC. Forehead confluently (at any rate on sides), and more or less rugulosely, punctulate.
D. Pronotum not or but little rugulose.
E. Raised edging of pronotum considerably thickened and more elevated round hind angles ... ... — dispar, *Blackb.*
EE. Raised edging of pronotum not thickened nor more elevated round hind angles ... — puncticollis, *Blackb.*
DD. Pronotum closely and very strongly scabrous ... ... — erosa, *Blackb.*

AA. Antennæ consisting of 9 joints.
B. Clypeus and forehead divided from each other by a deep furrow.
C. Lateral edging of pronotum notably more raised in front than in middle, with lateral gutter much dilated in front.
D. Raised edging of base of pronotum notably more elevated at the ends than in the middle ... ... — Nemesis, *Blackb.*
DD. Raised edging of base of pronotum continuously fine.
E. Sides of prothorax normally arched (almost as in *Sericesthis pruinosa*, Dalm.) ... — rorida, *Burm. (?)*
EE. Sides of prothorax much less strongly arched.
F. Pygidium non-carinate; size large (more than 7 l.) — hospes, *Blackb.*
FF. Pygidium longitudinally carinate (feebly in male, strongly in female); size small (about 5 l.) ... — calescens, *Blackb.*
CC. Lateral edging of pronotum even, or all but even.
D. Raised edging of pronotum obsolete in middle of base.
E. Elytral puncturation subrugulose; colour black or piceous above, dark piceous beneath.
F. Pygidium closely but not confluently punctulate ... — ambigua, *Blackb.*
FF. Pygidium confluently rugulose ... ... — coxalis, *Blackb.*

EE. Elytral puncturation non-rugulose; colour chestnut, with golden gloss	aureo-rufa, *Blanch.(?)*
DD. Raised edging of pronotum continuous across base.	
E. Front of clypeus gently emarginate	pallidula, *Macl.*
EE. Front of clypeus widely rounded.	
F. Joints of flabellum of male antennæ very much longer than joints 1-6 of antennæ tobether; head bicolorous	sericans, *Er.*
FF. Joints of flabellum of male antennæ scarcely longer than joints 1-6 of antennæ together; head unicolorous	subsericans, *Blackb.*
BB. Head continuously convex; clypeus separated from forehead only by a suture (at any rate in male) ...	juvenis, *Blackb.*

It seems well to preface my descriptions of new species with a note on the vestiture of the under surface. In the case of some species I have described the sterna as "sparsim pilosa," and have omitted mention of pilosity in describing others, calling them "subglabra." I do not attach much importance to this character. The vestiture of the sterna is easily rubbed off, and I am disposed to think that there is more or less pilosity (never close and conspicuous as it is in *Haplonycha)* on the sterna of fresh specimens of all *Scitalæ*. In dealing with single specimens, the describer, however, can record only pilosity which is present, and of course specimens must in some instances be described which are not in perfectly fresh condition.

S. rugosiceps, Blanch. My identification of this species is somewhat of the nature of a guess, as there is nothing in the description inconsistent with its being any one of rather numerous species. The probability, however, seems to be slightly in favour of *rugosiceps* having eight-jointed antennæ (though without any definite statement to that effect). If that be the case, the insect to which I apply the name is the only one known to me that size locality and colour in combination would indicate as likely to be *rugosiceps*. I suspect that this insect is also the original of Burmeister's description of *S. sericans*, Er. (though it is certainly not that species—*inter alia* because of its strongly punctulate scutellum), chiefly on account of its being, among the possible species known to me, that which agrees best with Burmeister's statement that the tarsi of *S. sericans* are devoid of setæ, the setæ of its tarsi being very inconspicuous and on the *hind* tarsi almost wanting. (For the identification of the true *S. sericans*, Er., see my remarks above).

S. convexicolliis, sp. nov., Mas (?). Ovata; sat convexa; nitida; subglabra; dilute brunnea, leviter aureo-micans, prothorace pedibusque rufescentibus; antennis 8-articulatis, flabello quam articuli 2-5 conjuncti vix longiori; palporum maxillarium articulo apicali ovali; clypeo confertim punctulato, antice sat fortiter reflexo-subtruncato; fronte sat plana sparsius punctulata transversim impressa; prothorace sat fortiter (fere ut 9 ad $5\frac{1}{2}$) transverso, fortiter gibbo, antice minus angustato, supra sparsius minus subtiliter punctulato, angulis anticis sat acutis posticis rotundato-obtusis haud explanatis, basi late rotundata; scutello punctulato; elytris leviter geminato-striatis, fere ut pronotum sed paullo magis crebre punctulatis; pygidio subplano sparsius subtiliter punctulato; segmentis ventralibus (lateribus exceptis) vix perspicue punctulatis, ultimo medio breviter lobato-producto; tibiis anticis extus 3-dentatis; tarsis posticis (exempli typici) subtus sparsissime setosis, articulo basali quam 2us sat breviori; coxis posticis quam metasternum quinta hujus parte brevioribus. Long. 5 l.; lat. $2\frac{3}{5}$ l.

Its strongly gibbous pronotum distinguishes this species readily from all others (known to me) to which it bears much superficial resemblance. From its ventral characters I think it must be a male, but the structure of its antennæ and hind tarsi is more suggestive of a female. The sexual characters and small size cause it to form (together with *S. nemoralis*, Blackb. and probably *Ino*, Blackb.) a distinct group in *Scitala* which may possibly be eventually regarded as another genus.

N. S. Wales. I have no record of the exact locality in which I captured it.

S. nemoralis, sp. nov. Mas. (?). Subelongata, leviter ovata; sat convexa; subnitida; subglabra; testaceo-brunnea, leviter iridescens, capite prothorace sternis pedibusque magis rufescentibus; antennis 8-articulatis, flabello quam articuli 2-5 conjuncti subbreviori; palporum maxillarium articulo apicali elongato-subcylindrico; clypeo confertim punctulato, antice vix subtruncato, modice reflexo; fronte sparsius subtilius punctulata, sat convexa; prothorace sat fortiter (ut 9 ad 5) transverso, antice minus angustato, supra subtilius crebrius punctulato, angulis anticis sat acutis posticis rotundato-obtusis haud explanatis, basi late leviter rotundata; scutello punctulato; elytris sat fortiter geminato-striatis, quam pronotum paullo magis crebre magis fortiter punctulatis; pygidio sat convexo, crebre sat subtiliter punctulato, antice obtuse longitudi-

naliter carinato : segmentis ventralibus sat obsolete punctulatis, ultimo medio breviter lobato-producto ; tibiis anticis extus 3-dentatis ; tarsis posticis (exempli typici) subtus minus sparsim setosis, articulo basali quam 2us sat breviori ; coxis posticis quam metasternum quinta hujus parte brevioribus. Long., 5 l. ; lat., $2\frac{1}{2}$ l.

Near *S. convexicollis*, Blackb., and no doubt the same sex as the type of that species, since the apical projection of the last ventral segment is almost sure to be sexual ; at the same time the much greater convexity of the pygidium in this species is suggestive of sexual difference. This species differs from *S. convexicollis* in many respects besides that of its pronotum being of normal convexity ; *inter alia*, the apical joint of its maxillary palpi is more slender and elongate, the puncturation of all parts of its dorsal surface except the pygidium is much finer ; that of its pronotum is evidently—and of its elytra considerably—closer ; its clypeus is more rounded in front ; the basal part of its pygidium is carinate : its surface is very evidently iridescent, and its tarsi are evidently more setose beneath.

New South Wales : I have unfortunately no record of the exact locality. This and the preceding species are both, I believe, from localities at no great distance from Narrabri, or at any rate in that direction, where I collected some *Scitalæ*.

S. Ino, sp. nov. Fem. Ovata ; convexa ; subnitida ; subglabra ; rufo-brunnea, iridescens ; antennis 8-articulatis, flabello quam articuli 2-5 conjuncti vix longiori ; palpis (exempli typici) carentibus ; clypeo crebre punctulato, antice rotundato modice reflexo ; fronte sparsim minus subtiliter punctulata, sat convexa ; prothorace sat fortiter (ut 9 ad 5) transverso, antice minus angustato, supra sparsius minus subtiliter punctulato, angulis anticis sat acutis posticis obtusis (vix rotundatim) haud explanatis ; basi late vix sinuatim rotundata ; scutello punctulato ; elytris sat fortiter geminato-striatis, fere ut pronotum punctulatis ; pygidio sat fortiter convexo crebrius minus subtiliter punctulato ; segmentis ventralibus sat obsolete punctulatis, ultimo late subtruncatim rotundato ; tibiis anticis (exempli typici) extus obtuse subobsolete 3-dentatis ; tarsis posticis (exempli typici) carentibus ; coxis posticis quam metasternum quinta hujus parte brevioribus. Long., 5 l. ; lat., $2\frac{2}{5}$ l.

The specimen here described is unfortunately not in good condition, but as it is the only female that I have seen which can be grouped with the preceding two species it seems de-

sirable to place its characters on record. Its sexual differences seem to consist chiefly in the evenly-rounded front margin of the clypeus, its antennal flabellum a little abbreviated, its ventral segments more massive and convex, and the hind margin of the apical ventral segment not produced in the middle. The obsolete sinuation of the external margin of the front tibiæ is probably due to some accidental cause. As a species it differs from *convexicollis* by its non-gibbose pronotum, its iridescent dorsal surface, much more conspicuously geminate striate elytra, etc., and from *nemoralis* by, *inter alia*, the notably stronger and less close puncturation of its frons pronotum and elytra. This species and the preceding two are very unsatisfactorily intermediate between *Scitala* and *Anodontonyx*, and bear much superficial resemblance to some species of the latter. They differ from both in the nature of their ventral sexual characters, from typical *Scitalæ* by the feebleness of the sexual characters of the antennæ, and from *Anodontonyx* by the flabellum of the antennæ being very evidently longer in both sexes.

Queensland; Brisbane (Mr. F. M. Bailey).

S. Nemesis, sp. nov. Ovata, sat elongata; sat convexa; minus nitida; subglabra, sternis femoribusque sparsim pilosis; testaceo-brunnea, nonnihil iridescens; antennis 9-articulatis; clypeo confertim rugulosius punctulato, antice rotundato, sat fortiter reflexo; fronte sat convexa, sat crebre minus subtiliter punctulata; prothorace quam longiori ut 7 ad 4 latiori, antice minus fortiter angustato, supra minus crebre minus subtiliter punctulato, lateribus sat arcuatis, margine laterali antice quam in parte mediana multo magis elevata, angulis anticis acutis posticis haud explanatis rotundato-obtusis, basi utrinque sat fortiter sinuata, margine basali angulos versus quam in parte mediana sat multo magis elevato; scutello vix punctulato; elytris sat fortiter geminato-striatis, sat fortiter sat crebre sat rugulose punctulatis; pygidio sat convexo, minus crebre minus subtiliter punctulato; segmentis ventralibus obsoletius punctulatis; tibiis anticis extus 3-dentatis; tarsis posticis subtus seriatim sat crebre setulosis, articulo basali quam 2us paulo longiori.

Maris antennarum flabello quam articuli 1-6 conjuncti paullo longiori, feminæ articulis 2-6 conjunctis sat æquali; segmento apicali ventrali postice maris late elevato et emarginato; feminæ truncato minus fortiter elevato. Long. 7-8 l.; lat. $3\frac{1}{5}$-$3\frac{3}{5}$ l.

A typical *Scitala;* distinct from all others known to me with nine-jointed antennæ by the raised lateral edging of its

protonotum being on the sides much more elevated in front than in the middle and on the base very evidently more elevated at the ends than in the middle. I have a female example of *Scitala* taken in South Australia which may represent a distinct species, but does not seem to differ from the female described above, except in the considerably closer puncturation of its pygidium.

South Australia; Fowler's Bay. Also from Western Australia.

S. rorida, Burm. This is one of the most difficult of identification among the *Scitalæ*. The description (colour and size being disregarded) will fit almost any member of the genus having 9-jointed antennæ. And, unfortunately, there is no indication—beyond the mention of Australia—of the locality in which this species occurs, unless a guess can be made from the mention of Mr. Melly as the donor of the type. Glancing through Burmeister's descriptions of Australian species, it is noticeable that most of those to which Mr. Melly's name is attached relate to insects that are found in New South Wales, and therefore the probabilities are in favour of the type of *rorida* having come from that State. I therefore select among the *Scitala* known to me from New South Wales that which best agrees in respect of size and colour with Burmeister's description, and apportion the name to a species that I met with in the Blue Mountains. It is a large dark-coloured insect with bright iridescence, its entire dorsal surface being of about the same colouring as the head and pronotum of *Sericesthis pruinosa*, Dalm., and on referring to Burmeister's descriptions of the two species I find that he uses exactly the same expression to characterize the dorsal surface of *rorida* and the head and pronotum of *pruinosa*—"*dunkelbraun lebhaft irisirend.*" The probability, therefore, seems to be in favour of the correctness of my identification. It should be noted, however, that the species appears to be very variable in colour (some specimens otherwise indistinguishable being of a pale iridescent brown tint) and widely distributed, since I have taken in the neighbourhood of Adelaide examples that seem quite identical with those taken near Sydney.

S. hospes, sp. nov. Sat late ovata; modice convexa; minus nitida; subglabra, sternis femoribusque sat sparsim pilosis; testaceo-brunnea, nonnihil aureo-micans, leviter iridescens; antennis 9-articulatis; clypeo confluenter ruguloso, antice late rotundato, modice reflexo; fronte sat convexa, antice crebre ruguloso postice gradatim minus crebre nec rugulose punctulata; prothorace quam longiori fere ut 7 ad 4 latiori, antice sat fortiter angustato, supra

minus crebre minus subtiliter subinæqualiter punctulato, lateribus parum arcuatis, margine laterali antice quam in parte mediana multo magis elevata, angulis anticis acutis posticis haud explanatis obtusis haud rotundatis, basi utrinque manifeste sinuata, margine basali æquali; scutello haud punctulato; elytris geminato-striatis (maris exempli typici parum fortiter), crebre sat fortiter minus rugulose punctulatis; pygidio fere ut pronotum punctulato; segmentis ventralibus obsoletius punctulatis; tibiis anticis extus 3-dentatis; tarsis posticis subtus seriatim setulosis, articulis basalibus 2 inter se sat æqualibus. Maris antennarum flabello quam articuli 1-6 conjuncti paullo longiori, feminæ articulis 2-6 conjunctis sat æquali; maris segmento apicali ventrali postice leviter elevato et emarginato, feminæ truncato vix elevato; maris quam feminæ pygidio multo magis convexo. Long. $7\frac{1}{2}$-8 l.; lat. $3\frac{4}{5}$-$4\frac{1}{5}$ l.

Closely allied to *S. rorida*, Burm. (?); possibly an Alpine race of that species. It is of more robust build and much less iridescent, with the sides of the prothorax very manifestly less rounded and more sinuate behind the middle (in both species there is more or less tendency to sinuosity, more apparent from some than from other points of view). The geminate-striation of the elytra is feebler, and their puncturation closer than in *rorida* (?). This form, even if not a valid species, is at any rate a very clearly distinguishable race-type. The specimens before me do not vary in colouring.

Victorian Alps; near a place called "The Hospice," 6,000 feet above the sea.

S. calescens, sp. nov. Sat elongata, parum ovata; sat convexa; subnitida; subglabra; brunneo-testacea, fronte picea; leviter iridescens; antennis 9-articulatis; clypeo crebre vix rugulose punctulato, antice late leviter subtruncato sat fortiter reflexo; fronte subfortiter vix crebre punctulata, sat convexa; prothorace quam longiori fere ut 7 ad 4 latiori, antice minus angustato, supra sat fortiter vix crebre punctulato, lateribus bisinuatis, margine laterali antice quam in parte mediana sat multo magis elevato, angulis anticis acutis posticis haud vel vix explanatis acute rectis, basi utrinque parum sinuata, margine basali angulos versus quam in parte mediana perspicue magis elevato; scutello vix manifeste (vel potius subtilissime) punctulato; elytris minus fortiter geminato-striatis sat fortiter minus crebre punctulatis; pygidio basin versus minus subtiliter nec crebre punctulato apicem versus crebre subtilius transversim ruguloso, longitudinaliter breviter plus minusve fortiter carinato; tibiis anticis

extus 3-dentatis; tarsis posticis subtus seriatim setulosis, articulo basali quam 2us breviori.

Maris antennarum flabello quam articuli 1-6 conjuncti paullo longiori, feminæ articulis 2-6 conjunctis sat æquali; maris quam feminæ tarsis manifeste longioribus; maris carina pygidiali parum perspicua in longitudinis medio sita, feminæ bene elevata basali; maris segmento ventrali apicali postice minus late emarginato et minus elevato, feminæ late subtruncato manifeste elevato. Long., 5-5⅗ l.; lat., 2½-2⅘ l.

The sexual characters in this species are unusually well marked and numerous. The lateral outline of its prothorax resembles that of *S. hospes*, Blackb. Its small size distinguishes it from its near allies. The basal joint of its hind tarsi, notably shorter in both sexes than the second joint, is also very distinctive; also the hind angles of its prothorax (viewed from above), sharply rectangular or even subacute. The hind coxæ are evidently, but not much, shorter than the metasternum.

North Queensland (Mr. R. C. L. Perkins).

S. ambigua, sp. nov. Ovata; convexa; robusta; minus nitida; subglabra; picea vel rufo-picea, pruinosa vix iridescens; antennis 9-articulatis; clypeo sat nitido, crebre leviter ruguloso, in medio sat gibbo, antice rotundato fortiter reflexo; fronte subtiliter minus crebre punctulata, modice convexa; prothorace quam longiori ut 7 ad 4 latiori, antice sat angustato, supra sat subtiliter sat crebre subobsolete punctulato, lateribus parum arcuatis, margine laterali sat æqualiter elevato sed sulco submarginali antice nonnihil dilatato, angulis anticis acutis posticis leviter obtusis vel obtuse rectis haud explanatis, basi utrinque sinuata, margine basali in medio obsoleto; scutello punctulato; elytris minus fortiter geminato-striatis, sat crebre minus profunde nec subtiliter punctulatis; coxis posticis quam metasternum parum brevioribus; pygidio crebre parum rugulose nec subtiliter punctulato sat convexo; tibiis anticis extus 3-dentatis; tarsis posticis subtus seriatim setulosis, articulo basali quam 2us sat longiori.

Maris antennarum flabello articulis 1-6 conjunctis sat æqualibus feminæ quam articuli 2-6 conjuncti vix longiori; maris quam feminæ tarsis posticis paullo longioribus; maris segmento ventrali apicali postice emarginato et elevato, feminæ subsinuatim truncato nec elevato. Long. 7-8¼ l.; lat. 3⅜-4 l.

This species bears some resemblance to *S. sericans*, Er.,

but *inter alia* is considerably larger, with the basal edging of the pronotum obsolete in the middle of the base, and the antennal flabellum of the male very much shorter and not curved. The present species differs also from *S. æneseens*, Burm., which, however, is very likely to be identical with *sericans*, Er.) by the flabellum of the male antennæ not being arched, as well as by its considerably larger size.

New South Wales; Sydney, etc. In my collection; also from Messrs. Sloane and Lea.

S. coxalis, sp. nov. Mas. (?). Ovata; convexa; robusta; minus nitida; subglabra, sternis femoribusque sparsim pilosis; supra brunneo-rubra nonnihil velutina pruinosa parum iridescens, subtus fere sanguinea, antennis palpisque pallide testaceis; antennis 9-articulatis, flabello quam articuli 1-6 conjuncti manifeste breviori; capite ut *S. ambiguæ*, Blackb.; prothorace quam longiori duplo latiori, antice sat angustato, supra sat crebre sat leviter minus subtiliter punctulato, lateribus leviter arcuatis, margine laterali sat æqualiter elevato, angulis anticis sat acutis posticis (superne visis) acute rectis haud explanatis, basi utrinque sinuata, margine basali in medio obsoleto; scutello punctulato; elytris minus fortiter geminato-striatis, sat fortiter sat crebre punctulatis; pygidio sat gibbo, confertim subgrosse ruguloso; tibiis anticis extus tridentatis; tarsis posticis subtus seriatim setulosis, articulo basali quam 2us sat longiori; coxis posticis quam metasternum haud brevioribus; segmento ventrali apicali postice leviter emarginato leviter elevato. Long. 7 l.; lat. $3\frac{3}{5}$ l.

The unique specimen described above is unsatisfactorily close to the preceding *(S. ambigua)*, but differs in a manner that will not allow it to be regarded as a mere variety. Its pygidium (strongly, very closely, and almost coarsely rugulose, and also strongly gibbous) is quite distinct from that of either sex of *S. ambigua;* its prothorax, moreover, is very manifestly more strongly transverse, and has sharper hind angles. The velvety appearance of its dorsal surface is very likely to be due to the fresh condition of the specimen when killed. The antero-lateral parts of the metasternum are confluently rugulose (in *ambigua* punctured—by no means confluently). The unique type, in spite of its short antennal flabellum, must be considered a male on account of its gibbous pygidium and quite strongly emarginate apical ventral segment.

New South Wales; probably from Mulwala (Mr. Sloane).

S. aureorufa, Blanch. There is very little in the description of this species to indicate any characters that are of specific value; no mention, for instance, of the structure of the

antennæ. At the time Blanchard wrote his description "antennæ consisting of eight joints" stood as a generic character of *Scitala*, and therefore it might be argued that its reference to that genus implied that its antennæ have only eight joints. I know no *Scitala* with eight-jointed antennæ likely (from colouring and habitat) to be this species, but I have before me two males and a female of a *Scitala* with nine-jointed antennæ from New South Wales (probably Blanchard's locality), agreeing in size and colouring with the description, and not departing from the description in respect of the few other characters mentioned. My identification of this insect is probably correct. Its distinctive structural characters are indicated in the preceding tabulation, and I may here add the information that in the male the antennal flabellum is slightly bent and slightly longer than the preceding six joints together, the apical ventral segment is only moderately emarginate and feebly elevated behind, and the pygidium strongly convex; while in the female the antennal flabellum scarcely exceeds in length joints 2-6 together, the apical ventral segment is widely subtruncate behind, and the pygidium is only feebly convex. In both sexes the tarsi are sparingly seriate-setulose beneath and (in the male even more than the female) the basal joint of the hind tarsi is notably longer than the second joint.

S. sericans, Er. I have already discussed my identification of this species *(vide supra)*, and have indicated some of its distinctive characters in the preceding tabulation. I will now add the following remarks:—I have examined a long series of specimens from Tasmania, Victoria, South Australia, and New South Wales; the species varies considerably in colouring, Erickson's description of it and Burmeister's description of his *S. æneseens* (which, as already remarked, may well be a variety of it) representing about the two extremes in this respect; in all the specimens that I have seen the forehead is conspicuously and abruptly of dark colour in contrast with the clypeus (this is noted by Erickson, but not by Burmeister); the elytra are not at all rugulose and (for a *Scitala)* are lightly and sparsely punctulate; the flabellum of the male antennæ is notably arched and very elongate, not surpassed in length by that of any *Scitala* known to me; the apical ventral segment of the male is feebly emarginate and feebly elevated behind (that of the female widely truncate and scarcely elevated); the pygidium is moderately convex, slightly more so in the male than in the female; the tarsi are seriate-setulose beneath; the basal joint of the hind tarsi is evidently or scarcely longer than the second joint; the hind coxæ are quite evidently, but not very much, shorter than the meta-

sternum. The variation in the relative lengths of the basal two joints of the hind tarsi is not only sexual, and possibly points to there being more than one species among the specimens before me, but I can find no other character by which to divide them.

S. subsericans, sp. nov., Mas. *S. sericanti*, Er. affinis; magis convexa; capite unicolori rufo; antennarum flabello recto quam articuli 1-6 conjuncti subbreviori; elytris subrugulose magis crebre magis fortiter punctulatis: tarsorum posticorum articulo basali quam 2us sat multo longiori; cetera ut *S. sericans*, Er. Long. 6¼ l.; lat. 3⅕ l.

The structure of the apical ventral segment is conclusive in determining the specimen before me to be a male, but the straight and very short flabellum of its antennæ separates it strongly from the species discussed above as *S. sericans*, in which the female flabellum is not much (though quite decidedly) shorter than that of the present insect. The general resemblance between the two is so close that it seems unnecessary to describe this insect at full length; in all respects not specified in the above Latin diagnosis it agrees with particulars given above as characterizing *S. sericans*.

New South Wales (Mr. Sloane; probably from Mulwala).

S. juvenis, sp. nov., Mas. Ovata; minus convexa; minus nitida; subglabra, sternis femoribusque sparsim pilosis; nigra, sat læte iridescens, elytris abdomine tibiisque picescentibus, antennis palpis tarsisque rufis; antennis 9-articulatis, articulo 6° perminuto, flabello quam articuli 1-6 conjuncti paullo longiori; capite sat æquali, crebre (postice paullo minus crebre) subtilius sat æqualiter punctulato, clypeo antice late rotundato sat reflexo; prothorace quam longiori ut 7 ad 4 latiori, antice modice angustato, supra fere ut clypeus (in medio nonnihil magis grosse) punctulato, sat convexo, lateribus sat rotundatis, margine laterali antice quam in parte mediana magis elevata, angulis anticis parum productis vix acutis posticis (superne visis) rectis haud explanatis, basi utrinque sinuata, margine basali in medio subobsoleto; scutello punctulato; elytris fortiter geminato-striatis, sat fortiter minus crebre punctulatis; pygidio sat convexo, sat crebre sat fortiter punctulato; tibiis anticis extus tridentatis; tarsis posticis (exempli typici) carentibus; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali postice late emarginato leviter elevato. Long. 4 l.; lat. 2 l.

An extremely isolated species in *Scitala*, but I can find no character on which to found generic distinction, unless it

be the peculiar form of the dorsal surface of the head in which the clypeus and forehead are scarcely distinguishable *inter se*, except by a fine (though well-marked) suture, and that does not appear sufficient. Its superficial resemblance is to *Platydesmus*, but *inter alia* its geminate-striate elytra are inconsistent with a place in that genus. The sixth joint of the antennæ is extremely minute, and without careful examination the antennæ appear to have only eight joints.

Victoria (Mr. Kershaw).

Anodontonyx.

This genus was characterized by Dr. Sharp in 1890 in an American publication, "Insect Life" (vol. ii. p. 302). In the same year I described (P.L.S., N.S.W., pp. 546, etc.), under the generic name *Sericesthis*, three species which seem to be members of Dr. Sharp's genus. I attributed them to *Sericesthis* on the assumption that Lacordaire, Burmeister, etc., were right in regarding the typical species of *Scitala* and *Sericesthis* as congeneric, *Sericesthis* being the earlier name of the two. Subsequent study has led me to the conclusion that the two names are both of generic value, and had I made that discovery at the time I described the species in question I should have attributed them to *Scitala;* I failed to do so only because the distinctness of the two genera had up to that time escaped notice, and I regarded *Scitala* as a mere synonym of *Sericesthis*, as I explained fully at the time (loc. cit.). *Anodontonyx* is very close to *Scitala* (as Dr. Sharp remarks), and I am not at all confident that the discovery of new species intermediate in their characters will not eventually be fatal to its claim to be regarded as a good genus; I do not think that I should venture to found a new genus for its species if Dr. Sharp had not done so. I have already *(vide supra)* described as *Scitala Ino* an insect which certainly departs from *Scitala* in the direction of *Anodontonyx*. Only one of the characters attributed to *Anodontonyx* seems to me really to distinguish its species from all the species of *Scitala*—viz., *"(antennarum) clava perbrevi,"* and even this needs amplification by the additional statement that in *Anodontonyx* (so far as at present known) antennal sexual characters are almost non-existent. However, as the genus has been formed, and its known species are certainly distinguishable by the antennal character, I think it should be retained, at any rate provisionally. And here it seems necessary to remark that the two species described by Dr. Sharp as members of *Anodontonyx* differ from each other by a character that seems to me even more important from the generic point of view than the antennal structure, which (I have several times

already expressed the opinion) is of singularly slight value among the Australian *Sericoides*. I refer to the vestiture of the sterna, which in the first species described (*vigilans*, the typical species I presume) are said to be "fere nuda," while in the other species (*Harti*) they are called "parum hirsuta." I have before me specimens in good condition which are either identical with the two species under discussion or extremely close to them (see notes below), and I find that in one of those species the sterna are almost without pilosity (more nearly glabrous than I believe any *Scitala* to be when in fresh condition), and in the other notably more pilose than in any *Scitala* known to me. It is therefore quite possible,—inasmuch as the pilosity in the Australian *Sericoides* certainly has its distinctive types running through whole series of species that are associated by other well-marked generic characters—that whether *Anodontonyx* stand as a good genus or not, another new generic name may eventually be considered desirable for the species Dr. Sharp described as *A. Harti*, and for some others closely allied to it, which are noted in the following pages.

In respect of the already described species attributable to *Anodontonyx*, I think they have been described under eight names (one of which, *A. (Scitala) languida*, Er., seems to be merely a synonym of *A. (Sericesthis) nigrolineata*, Boisd.), viz., Dr. Sharp's two and the five that I have already indicated under the heading of *Scitala* (above). To these I now add nine additional. The following table will show characters by which the species of the genus may be identified. The subsequent pages contain descriptions of the new species, and notes on those previously named. The descriptions of three species (*A. vigilans*, Shp., *Harti*, Shp., and *rugosula*, Har.) do not indicate characters that enable me to place those species in my tabulation.

A. Antennæ consisting of only eight joints.
  B. Joint 2 of antennæ more or less globular, and considerably stouter than third joint.
    C. Hind corners of pronotum not explanate. Head non-pilose, unless on margin.
      D. Prothorax at its widest not behind middle.
        E. Pronotum moderately closely and not particularly finely punctulate.
          F. Prothorax quite (or all but) twice as wide as long.
            G. Dorsal surface not iridescent.

H. Intermediate tarsi nearly twice as long as their tibiæ ... planiceps, *Blackb.*
HH. Intermediate tarsi very little longer than their tibiæ ... parvipes, *Blackb.*
GG. Dorsal surface somewhat brilliantly iridescent ... ... gravicollis, *Blackb.*
FF. Prothorax much less transverse ... ... tetricus, *Blackb.*
EE. Pronotum very finely and sparsely punctulate ... ... consanguineus, *Blackb.*
DD. Prothorax at its widest behind middle.
E. Hind angles of prothorax from all points of view rounded or very obtuse.
F. Lateral parts of pronotum very closely (almost confluently) punctulate ... creber, *Blackb.*
FF. Lateral parts of pronotum much less closely punctulate.
G. Body entirely atro-cyaneous (strongly iridescent) ... ... micans, *Blackb.*
GG. Body ferruginous or testaceous.
H. Hind angles of prothorax quite distinct, though strongly obtuse chalceus, *Blackb.*
HH. Hind angles of prothorax quite rounded off ... ... indignus, *Blackb.*
EE. Hind angles of prothorax rectangular (viewed from above), scarcely blunted ... rectangulus, *Blackb.*
CC. Hind corners of prothorax quite strongly explanate. Head pilose nigrolineata, *Boisd.*
BB. Joint 2 of antennæ quite slender (as the 3rd joint) ... ... antennalis, *Blackb.*
AA. Antennæ consisting of nine joints ... hirticeps, *Blackb.*

A. Harti, Shp. This species must be extraordinarily close to my *A. (Sericesthis) planiceps*, which was described almost simultaneously with it. Nevertheless as Dr. Sharp states that the pygidium of *Harti* is "smooth towards the apex," and I find no trace of such a character in any of the numerous specimens before me of *planiceps*, I am obliged to treat them as distinct species. And here I may remark that, in spite of the apparent likelihood of the female differing from the male as indicated by Dr. Sharp, I am by no means satisfied that the specimens which he regarded as females of *Harti* are not really examples of another species. I have specimens of *A. planiceps* presenting no definite tarsal differences *inter se*, which seem to

be certainly distinct in point of sex, differing in the structure of the pygidium and apical ventral segment. If Dr. Sharp were right concerning the sexes of *A. Harti* it is probable that my *A. (Sericesthis) parvipes* would have to be deemed the female of *A. planiceps*, but I hesitate much to accept this conclusion because, in addition to the objection arising from the presence of differences that can hardly be non-sexual among my speciments of *planiceps*, I find differences between that species and *parvipes* which do not seem likely to be sexual, especially in the maxillary palpi (the penultimate joint of which is in *planiceps* notably longer than in *parvipes*). If it were not for the irreconcilable difference between the sculpture attributed by Sharp to the pygidium of *Harti* and the sculpture of the corresponding part in *planiceps* and *parvipes*, I should feel little doubt that the latter two are identical with what Sharp described as male and female of *Harti*. I may add, however, that I am unable to understand Sharp's statement that the prosternum of *Harti* has only a "single" carina behind the coxæ, since that seems to be intended as a character to distinguish it from *A. vigilans*, in which the prosternum is said to have a "prominent acute lamina" behind the coxæ, with no reference to the presence of two or more carinæ. *A. planiceps* has a single small cariniform projection behind its coxæ.

A. vigilans, Shp. I am regretfully compelled to disregard this species, as incapable of identification. The diagnosis furnished by its author would apply to at least half-a-dozen species known to me, and there is nothing in the appended note which distingushes it from any one of four of the species before me. As, however, Sharp makes no mention of his species being pruinose or iridescent, and states that the hind angles of the prothorax are rounded off—and in the only non-iridescent species known to me and resembling *vigilans* in size and colouring the hind angles of the prothorax are not rounded off—it is probable that I have not seen *A. vigilans*. Of the species known to me, *A. chalceus*, Blackb., is nearest to agreement with Sharp's description, and were it not for its iridescence I should name it "*vigilans*, Shp. (?)." I do not find it to be the case with these insects that iridescence fades with age.

A. gravicollis, sp. nov. Ovatus; convexus; modice nitidus; subglaber; purpureo-brunneus supra læte iridescens, clypeo antennis palpis pygidio pedibus corporeque subtus brunneo-testaceis; antennis 8-articulatis, flabello perbrevi; clypeo confertim, fronte sat crebre, minus subtiliter punctulatis; prothorace quam longiori fere duplo latiori, antice minus angustato (latitudine majori superne visa nonnihil ante medium sita), supra subfortiter sat crebre (latera

versus confertim subtilius) punctulato, vix perspicue canaliculato, lateribus minus rotundatis, angulis anticis vix acutis minus productis posticis (superne visis) obtuse rectis, basi marginata utrinque parum sinuata; scutello punctulato; elytris geminato-striatis, sat crebre subfortiter punctulatis; pygidio subfortiter vix crebre (in parte mediana fere lævi) punctulato; tibiis anticis fortiter tridentatis; tarsis posticis minus elongatis minus robustis, articulo basali 2° longitudine sat æquali; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali postice truncato. Long., $4\frac{4}{5}$ l.; lat., $2\frac{3}{5}$ l.

The most distinctive characters of this species (in comparison with its immediate allies) seem to be the purplish-red tone of colour of its dorsal surface—perhaps not constant—its bright iridescence, and the form of its prothorax (comparatively wide in front, with the greatest width slightly in front of the middle). When I described *A. micans* (Pr. Lin. Soc., N.S.W., 1890, p. 546), I unfortunately confused this species with it as a colour var., and wrote the diagnosis with a view to indicate a much greater variety of colouring than I have now any reason to think can be found in that species. The specimen described was one of those called in the appended note "a bright blue insect." Consequently I have found it necessary to provide a correction of the description of *A. micans (vide infra)*. I believe the type of *A. gravicollis* to be a female.

South Australia.

A. tetricus, sp. nov. Ovatus vel subovalis; modice convexus; minus nitidus; metasterno longe minus crebre setoso; niger vel piceo-niger, antennis palpis tarsis et (nonnullorum exemplorum, ? alterutrius sexus) tibiis anticis rufis; antennis 8-articulatis, flabello perbrevi; clypeo confertim subrugulose, fronte sat crebre, subfortiter punctulatis; prothorace quam longiori ut 8 ad 5 latiori, antice sat angustato, supra sat crebre subfortiter punctulato, vix perspicue canaliculato, lateribus leviter arcuatis, angulis anticis vix acutis parum productis posticis (superne visis) rectis, basi marginata utrinque leviter sinuata; scutello punctulato; elytris fortiter geminato-striatis, crebre sat fortiter punctulatis, interstitiis inter striarum paria sat fortiter convexis; pygidio minus crebre vix fortiter punctulato; tibiis anticis extus tridentatis; tarsis elongatis robustis, posticorum articulo basali quam 2us vix breviori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali postice leviter vel vix emarginato. Long., $4\frac{1}{2}$-$5\frac{1}{2}$ l.; lat., $2\frac{1}{5}$-$2\frac{2}{5}$ l.

Of this insect five specimens are before me, but I can find

no differences among them that I can confidently affirm to be sexual. Some examples are decidedly ovate, others scarcely dilated behind the middle; in four the front tibiæ are red, in one black; in three the pygidium is distinctly more convex than in the two others; in three the apical ventral segment is decidedly emarginate behind, in two scarcely emarginate. The species is very distinct from *planiceps*, Blackb., not only by its colouring, but also by, *inter alia*, the much less strongly rounded sides of its pronotum, the much more strongly convex interstices between the striæ of each pair of geminate striæ, and the maxillary palpi (especially the penultimate joint) notably shorter.

New South Wales: Bathurst, Jenolan Caves, etc.

A. consanguineus, sp. nov. Ovalis; sat convexus; pronoto sparsim subtiliter punctulato, basi utrinque vix sinuata; scutello vix perspicue punctulato; elytris minus crebre punctulatis; cetera ut *A. tetricus*, *Blackb.* Long., 5 l.; lat., $2\frac{1}{5}$ l.

It seems unnecessary to repeat the characters which this species shares with *A. tetricus;* the diagnosis of that species correctly describes the present one except in respect of the characters noted above, which are strongly marked ones. The front tibiæ of this species are red and the apical ventral segment is scarcely emarginate behind. The punctures of the pronotum in this species are very much finer than in *A. planiceps*, Blackb.; in *A. tetricus* they are a trifle coarser and stronger than in the latter.

New South Wales: Bathurst.

A. creber, sp. nov. Leviter ovatus (subparallelus); convexus; sat nitidus; subglaber; ferrugineus; supra sat irides-cens; antennis 8-articulatis, flabello perbrevi; clypeo confertim, fronte sat crebre, sat subtiliter punctulatis; prothorace quam longiori fere duplo latiori, antice sat angustato, supra sat subtiliter sat crebre (latera versus fere confluenter) punctulato, antice leviter canaliculato, lateribus sat rotundatis, angulis anticis acutis sat productis posticis nullis, basi marginata utrinque leviter sinuata; scutello punctulato; elytris geminato-striatis, crebre minus fortiter punctulatis; pygidio crebre vix fortiter punctulato; tibiis anticis extus fortiter tridentatis; tarsis posticis modicis minus robustis, articulo basali quam 2us sat breviori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali transversim concavo postice late rotundato (fere subtruncato). Long., 5 l.; lat., $2\frac{3}{5}$ l.

Less ovate and a little more elongate than *A. indignus*, Blackb., and easily distinguishable from it by the notably finer and closer puncturation of its head pronotum and elytra. The elytral punctures on the interval between the subsutural stria and the next pair of striæ would, if placed in regular rows, form five rows in this species, but would form only four rows in *indignus*. On account of its somewhat less robust tarsi I think it likely that the type of this species is a female.

South Australia: near Adelaide.

A. (Sericesthis) micans, Blackb. As noted above under the heading of *A. gravicollis*, sp. nov., I find it necessary to amend the description of *A. micans* as follows:—For "rufa, capite prothorace elytrisque rufo-cœruleis iridescentibus," read "atro-cœruleus, læte iridescens, palpis antennis tarsisque rufescentibus"; and in the last line of the diagnosis, to "truncato" add "vel leviter emarginato."

A. chalceus, sp. nov. Ovatus; convexus; sat nitidus; subglaber; rufo-testaceus, supra iridescens; antennis 8-articulatis, flabello perbrevi; clypeo confertim, fronte minus crebre, parum fortiter punctulatis; prothorace nitido, quam longiori fere duplo latiori, antice sat angustato, supra subfortiter sat crebre (latera versus magis crebre) punctulato, parum manifeste canaliculato, lateribus sat rotundatis, angulis anticis acutis sat productis posticis (superne visis) obtusis, basi marginata utrinque manifeste sinuata; scutello punctulato; elytris geminato-striatis, sat crebre subfortiter punctulatis; pygidio sat crebre vix fortiter punctulato; tibiis anticis extus tridentatis; tarsis posticis modice elongatis sat robustis, articulo basali quam 2us nonnihil breviori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali postice leviter emarginato. Long., 6 l.; lat., 3 l.

Rather brightly iridescent, the iridescence in some lights having a brassy tone. Among the species bearing a general resemblance to it in size colouring and vestiture this species is distinct by its pronotum at its widest evidently behind the middle (viewed from above) and having puncturation which becomes only moderately closer and finer near the lateral margins; also by its pronotum being notably more nitid than in its immediate allies. I am doubtful of the sex of the type. The decidedly emarginate apex of the apical ventral segment, and the somewhat elongate and robust hind tarsi, perhaps indicate its being a male. I have two specimens of narrower and less ovate build and having somewhat less robust tarsi, but not otherwise noticeably different, which may be the other sex, but it is quite possible that they represent another species.

In this species the prothorax is evidently less convex than in most of its allies *(e.g., creber*, Blackb., *gravicollis*, Blackb.) which may be readily seen if specimens be looked at from in front, and which moreover causes the pronotum viewed from the side to appear not so high from the lower to the upper (as seen from that point of view) outline as in *creber*, etc.

New South Wales: Braidwood.

A. indignus, sp. nov. Ovatus; convexus; modice nitidus; subglaber; ferrugineus; supra sat iridescens; antennis 8-articulatis, flabello perbrevi; clypeo confertim subrugulose, fronte sat crebre, sat fortiter punctulatis; prothorace quam longiori duplo latiori, antice sat angustato, supra sat crebre (nonnihil acervatim) sat fortiter punctulato, antice leviter canaliculato, lateribus sat rotundatis, angulis anticis acutis sat productis posticis nullis, basi marginata utrinque leviter sinuata; scutello punctulato; elytris geminato-striatis, fere ut pronotum sed nonnihil subseriatim punctulatis; pygidio crebre subfortiter punctulato; tibiis anticis extus fortiter tridentatis; tarsis posticis modicis minus gracilibus, articulo basali quam 2us manifeste breviori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali transversim leviter concavo, postice late rotundato. Long., 5 l.; lat., $2\frac{4}{5}$ l.

This species is distinguishable among its immediate allies by the hind angles of its prothorax entirely rounded off, in combination with comparatively strong and not very close puncturation of its pronotum, which is about as close and fine as—but a little stronger than—the corresponding sculpture in the species which I regard (and which stands generally in collections) as *Sericesthis (Melolontha) pruinosa*, Dalm. I am in some doubt of the sex of the specimens before me, but am disposed to think them males on account of the comparative stoutness of the tarsi, which are certainly more slender in some specimens of at least one allied species.

South Australia: taken, I think, near Adelaide.

A. rectangulus, sp. nov. Elongatus, vix ovatus; sat convexus; modice nitidus; subglaber; ferrugineus, supra leviter iridescens; antennis 8-articulatis, flabello perbrevi; clypeo confertim, fronte minus crebre, parum fortiter punctulatis; prothorace nitido, quam longiori fere duplo latiori, antice minus angustato, supra subfortiter sat crebre (latera versus paullo magis subtiliter paullo magis crebre) punctulato, vix perspicue canaliculato, lateribus modice arcuatis, angulis anticis acutis modice productis posticis bene determinatis obtusis (superne visis, fere rectis), basi

marginata utrinque parum sinuata; scutello punctulato; elytris geminato-striatis, sat crebre subfortiter punctulatis; pygidio sat crebre subfortiter punctulato; tibiis anticis extus tridentatis; tarsis posticis modicis, articulo basali quam 2us manifeste breviori; coxis posticis quam metasternum sat multo brevioribus; segmento ventrali apicali leviter emarginato. Long., $4\frac{1}{2}$ l.; lat., $2\frac{1}{5}$ l.

Easily distinguishable from its near allies by the well-defined hind angles of its prothorax, which, viewed from above, seem to be almost right angles, but when looked at from the side are seen to be in reality decidedly obtuse. I have four specimens which I took flying in the evening; all are in good condition. I can find no difference likely to be sexual among them, unless it be that one of them is more ovate and a little less elongate than the others. The body beneath is very nitid, the metasternum with only a few fine hairs.

New South Wales: Blue Mountains.

A. (Scitala) languida, Er. (*? = Sericesthis nigrolineata*, Boisd.). In a former memoir (Pr. Lin. Soc., N.S.W., 1890, pp. 541, etc.) I have discussed the various species which Boisduval named (the word "described" is hardly applicable) under the undescribed generic name *Sericesthis*, and in that memoir I indicated (as was then the case) that I had no specimen before me which I could confidently identify with *A. languida*, Er., but mentioned that previous authors had made the name a synonym of *A. nigrolineata*, Boisd. Having subsequently seen, as noted under *Scitala*, the type of *S. languida*, Er., I am able to say that the synonymy cited is probably correct, for the following reasons. There are two species, and only two, known to me which the very short description of *nigrolineata* will fit, viz., that which is accepted (correctly, I believe), as *Sericesthis (Melolontha) pruinosa*, Dalm., and *Anodontonyx (Scitala) languida*, Er. That the latter is the species Boisduval described rests upon the authority of Blanchard. Now Blanchard presumably had before him the type of Boisduval's species, but certainly not that of *languida*, nor of *S. pruinosa*, Dalm. He, however, had before him Tasmanian specimens of an insect which he regarded as *languida*, Er There can be little doubt that he was right in so regarding them, so far as I can judge, inasmuch as I have never seen *S. pruinosa*, Dalm., from Tasmania, and should probably have done so if it occurred (at any rate commonly) in Tasmania; and, moreover, if it had been before Blanchard he could not possibly have supposed it to be *languida*, Er. The conclusion, therefore, seems unavoidable that the very recognizably-described *A. languida* must be regarded as identical with the

scarcely-described *A. nigrolineata* of Boisduval, and that the latter name must stand.

(2) *A. (Sericesthis) nigrolineata*, Boisd. This is a common species and seems to be widely distributed, as I have specimens that seem to be specifically identical from various localities in Tasmania, Victoria, and New South Wales. I can find no well-defined sexual differences among them; some, however (which I take to be males) are of subparallel elongate form with the ventral segments much flattened, while others are somewhat strongly ovate in form, with ventral segments more convex.

A. hirticeps, sp. nov. Ovatus vel sat parallelus; convexus; minus nitidus; subglaber, sed capite antice setis elongatis erectis vestito; antennis 9-articulatis, flabello perbrevi; clypeo confertim, fronte sat crebre, subfortiter punctulatis; prothorace quam longiori vix fere duplo latiori, antice sat angustato, supra minus crebre parum subtiliter nec profunde punctulato, vix perspicue canaliculato, lateribus parum arcuatis, angulis anticis acutis posticis acute rectis, basi marginata utrinque parum sinuata; scutello punctulato; elytris geminato-striatis, fortiter fere subrugulose punctulatis; pygidio sat crebre minus fortiter punctulato; tibiis anticis extus tridentatis; tarsis posticis modicis, articulo basali quam 2us manifeste breviori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali postice haud vel vix emarginato. Long., $4\frac{2}{5}$-$5\frac{1}{2}$ l.; lat., 2-$2\frac{1}{2}$ l.

This is the only *Anodontonyx* known to me with antennæ of 9 joints. Its resemblance is to *A. nigrolineata*, Boisd., from which it differs, independently of its antennæ, by, *inter alia*, its very evidently less rugulose elytra. I do not find any definite sexual differences among the four specimens before me.

New South Wales: Sydney.

A. antennalis, sp. nov. Leviter ovatus; minus convexus; parum nitidus; subglaber, clypeo (exempli typici) setis elongatis erectis perpaucis vestito; hoc fortiter minus confertim, fronte sparsim subtiliter, punctulatis; antennis 8-articulatis, articulo 2° gracili sat elongato, flabello perbrevi; palporum maxillarium articulo apicali quam penultimus vix dimidio longiori; prothorace quam longiori fere duplo latiori, antice minus angustato, supra crebre subtiliter (latera versus, confertim) punctulato, haud (exempli typici) canaliculato, lateribus leviter arcuatis, angulis anticis posticis (superne visis) acute rec-

(2) *Vide infra* (Note A).

tis, basi marginata utrinque leviter sinuata; scutello punctulato; elytris geminato-striatis, sat fortiter sat crebre fere subrugulose, punctulatis; pygidio confertim fortius subrugulose punctulato; tibiis anticis extus tridentatis; tarsis posticis sat elongatis, articulo basali quam 2us sat breviori; coxis posticis quam metasternum duplo brevioribus; segmento ventrali apicali postice manifeste emarginato. Long., 4 l.; lat., 2 l.

This species is an extremely isolated one in respect of several characters. Its short maxillary palpi (especially the short apical joint) are remarkable. Its antennæ are quite unique in the genus (if not among all the Australian *Sericoides*), the second joint being (not a part of the scape, which consists only of the basal joint, but) evidently a part of the stipes, and not at all thicker than the 3rd joint. The general appearance is that of a very small specimen of *A. nigrolineata*, Boisd. I believe the type to be a male.

New South Wales: near the National Park.

Nosphisthis.

I have not anything to be added to my remarks on this genus in Tr. R. Soc., 1898, pp. 38, 39; but have recently received a second species of which the following is a description.

N. Perkinsi, sp. nov. Sat nitida; testacea, supra magis ferruginea; pilis elongatis fimbriata; corpore subtus pygidioque pilosis; capite confertim rugulose punctulato, clypeo late truncato-rotundato antice fortiter reflexo; palporum maxillarium articulo penultimo quam antepenultimus sat multo breviori; antennis 9-articulatis, flabello perbrevi quadrato 3-articulato; prothorace sat fortiter transverso, minus convexo, antice fortiter angustato, perspicue canaliculato, quam caput multo sparsius punctulato, lateribus arcuatis, angulis anticis vix acutis posticis obtusis, basi utrinque leviter sinuata; scutello punctulato; elytris æqualiter sat fortiter striatis, interstitiis leviter convexis fortius vix crebre punctulatis; pygidio subnitido, confertim subtiliter subaspere punctulato; tarsis sat brevibus, articulo apicali inter unguiculorum baseos lamina utrinque instructo, posticorum articulo basali quam 2us sat breviori; coxis posticis brevibus. Long., $5\frac{1}{2}$ l.; lat., $2\frac{1}{2}$ l.

Notably smaller and of narrower form than *N. parvicornis*, Blackb. The type is much paler in colour. The prothorax is much less convex transversely (*i.e.*, much less declivous on the sides). The elytra are more regularly striate (in *parvicornis* there is an evident want of evenness in the sub-

lateral striæ making some of the interstices wider in some than in other parts of their length.). The elytral interstices are more decidedly convex, the pygidium more nitid and by no means so extremely closely punctulate, and the penultimate joint of the maxillary palpi is shorter (in *parvicornis* longer) than the antepenultimate joint.

North Queensland. Sent by Mr. Perkins.

Frenchella.

Although this genus was founded so recently as in 1892, species referable to it seem to have been described under other generic names by most of the earlier authors. It is undoubtedly a near ally of *Haplonycha*, but the entirely different character of the elytral sculpture in its species from that of the species of *Haplonycha* (with no intermediate forms, so far as I have observed) appears to me fully to warrant a separate generic name. An elytral sculpture uniform in kind unquestionably accompanies persistent structural characters of apparently greater importance through all the extensive genera of Australian *Sericoides*, from which it may fairly be concluded that a particular type of elytral sculpture is generic. If *Frenchella* were included in *Haplonycha* the genus so constituted would furnish the only instance known to me of any considerable variety in kind (as distinguished from degree) in elytral sculpture within the limits of a genus.

The assignment to *Frenchella* of species described by the early authors is a matter of considerable difficulty and calls for a separate note on each of those which there seems to be any ground for referring to the genus.

Haplonycha rugosa, Burm. On full reflection I think that this is most probably the species that I called *Frenchella aspericollis*, and I therefore propose to sink my name in favour of Burmeister's.

Haplonycha striatella, Blanch. The phrase "elytris transversim confluenter punctatis" in Blanchard's description fits no Australian *Sericoid* species known to me except *Diphyllocera kirbyana*, White. Unfortunately Blanchard gives no information beyond "N. Holland" as to the habitat of his species and no statement of size except that it is "smaller than *H. obesa* and *scutalis*." The description of *H. striatella* fits the female of *D. kirbyana* very well except that the scutellum is called "læve," which it is not in *kirbyana*, but nevertheless I believe it to be that insect. I cannot find any mention of *D. kirbyana* under that name in Blanchard.

Haplonycha iridescens, Blanch. I identify this species with confidence. Its characters will be found indicated in the following tabulation.

A. Antennæ consisting of only eight joints.
  B. Pronotum punctured much less closely than the head ... ... hispida, *Blackb.*
  BB. Pronotum (especially on the lateral parts) punctured scarcely or not less closely than head.
    C. Pygidium not distinctly carinate, and scarcely rugulose ... ... approximans, *Blackb.*
    CC. Pygidium very strongly carinate and rugulose ... ... rugosa, *Burm.*
AA. Antennæ consisting of nine joints.
  B. Hind angles of prothorax sharply defined.
    C. Head and pronotum clothed with long erect fine hairs ... ... hirticollis, *Blackb.*
    CC. Head and pronotum glabrous (unless at margins).
      D. Puncturation of elytra rugulose and somewhat close ... ... iridescens, *Blanch.*
      DD. Puncturation of elytra non-rugulose and much less close ... sparsiceps, *Blackb.*
  BB. Hind angles of prothorax rounded off, or very obtuse.
    C. Prothorax considerably less than twice as wide as long ... ... lubrica, *Blackb.*
    CC. Prothorax fully twice as wide as long ... ... calorata, *Blackb.*

F. calorata, sp. nov. Ovata, convexa; parum nitida; supra subglabra; subtus sat pilosa; antennis 9-articulatis, flabello modico quam articuli 2-6 conjuncti sublongiori; capite pronotoque confertim minus fortiter sat rugulose sat æqualiter punctulatis; prothorace quam longiori duplo latiori, antice modice angustato, supra haud canaliculato, lateribus sat fortiter rotundatis, angulis anticis acutis modice productis posticis rotundatis, basi marginata utrinque vix manifeste sinuata; scutello confertim subtilissime punctulato; elytris obsolete striatis, interstitiis latis planis vix crebre sat subtiliter punctulatis; pygidio confertim subtilissime punctulato; tibiis anticis fortiter dilatatis extus obtuse bidentatis; tarsis posticis minus elongatis, articulo basali quam 2us sublongiori; coxis posticis quam metasternum multo brevioribus; segmento ventrali apicali truncato. Long., 6 l.; lat., $3\frac{1}{5}$ l.

I feel some hesitation in placing this species in *Frenchella*. I have no doubt the unique type is a female, and it is quite likely that the discovery of the male will eventually involve the creation of a new genus for its reception. I do not, however, find any definite character in the female inconsistent with its being a *Frenchella* except the remarkable structure of its front tibiæ, which are those of a *Pachygastra*, from which genus its large head, broad clypeus and elytral striæ non-geminate, *inter alia*,

separate it very widely. In my tabulation of the Australian *Sericoid* genera (Tr.R.S., S.A., 1898, pp. 32-34) I relied upon the remarkable form of the front tibiæ as a generic character, which renders it necessary for me to add *(vide infra)* a note on *Pachygastra* calling attention to this insect which, in the absence of the male, I must regard as a *Frenchella* presenting a very exceptional character. It should be noted that in this species the apical joint of the labial palpi, without differing very strongly from the *Frenchella* type, is certainly less elongate and cylindrical than in the other species known to me of the genus.

North Queensland. Sent by Mr. Koebele.

Platydesmus.

The species of this genus have been found as yet (so far as I know) only in New South Wales and Queensland. They are somewhat closely allied to *Frenchella*, but are readily distinguishable from that genus by the structure of their labial palpi. They are for the most part notably smaller than the species of *Frenchella* and are insects of less robust build, with the antennal sexual characters—so far as known—more pronounced, the flabellum of the male, at any rate, being notably longer, and the antennal difference between the sexes being in the one species of which the female is known very much greater. The antennæ in all the known species consist of nine joints and in all except one the flabellum has only three joints. The following table indicates characters by which the known species may be identified. They are for the most part insects of dull colours and not particularly interesting appearance.

A. Antennal flabellum consisting of only three laminæ.	
B. Basal 2 joints of hind tarsi scarcely differing in length.	
C. Pronotum coarsely punctulate ...	sulcipennis, *Macl.*
CC. Pronotum finely punctulate ...	obscuricornis, *Blanch.?*
BB. Basal joint of hind tarsi notably shorter than 2nd joint.	
C. Prothorax fully twice as wide as long	major, *Blackb.*
CC. Prothorax notably narrower ...	inamœnus, *Blackb.*
AA. Antennal flabellum consisting of four laminæ	inusitatus, *Blackb.*

P. (Haplonycha) obscuricornis, Blanch. I have before me several specimens of a *Platydesmus* (from the neighbourhood of Sydney) which appear to be in all probability identical with Blanchard's *Haplonycha obscuricornis*. I should consider the identification quite reliable if it were not that a discrepancy certainly exists in respect of the colouring of the

antennæ. Blanchard says "antennis obscure rufis, clava picea." "Obscure rufæ" is fairly applicable to the antennæ of the species before me, but I do not find that the flabellum of any of the specimens is conspicuously darker than the preceding joints. The agreement, however, with the description is so satisfactory in all other respects that I am disposed to conjecture the antennal flabella of the type to have been discoloured by some accidental means and to give this *Platydesmus* the name "*P. (Haplonycha) obscuricornis*, Blanch. (?)." It is an insect somewhat closely allied to *P. sulcipennis*, Macl., which is the type of the genus, differing from it *inter alia* by the closer and considerably finer puncturation of the dorsal surface. In the present species the dorsal puncturation in all parts is not much different from the corresponding puncturation in the common species known as *Sericesthis (Melolontha) pruinosa*, Dalm.; in *sulcipennis* much coarser. In colour this insect is extremely variable, only one of the specimens known to me being coloured (disregarding the antennal flabellum) as the type, in the rest the head pronotum elytra pygidium legs and undersurface being some or all of them more or less reddish. One of the specimens before me is evidently a female—the only female *Platydesmus* that I have seen. It is of evidently robuster and more convex form than the male, with the antennal flabellum much shorter (scarcely longer than joints 2-6 together), the tarsi evidently smaller, the pygidium less convex, the abdomen very convex longitudinally (*i.e.* as viewed from the side), with its apical segment widely rounded behind. In the male the abdomen is much flattened, with its apical segment not conspicuously different from that of the female.

P. sulcipennis, Macl. My specimen of this insect was given to me by Sir W. Macleay, and I have since compared it with the typical example.

P. major, sp. nov. Mas. Ovalis; sat niditus; supra subglaber, lateribus ciliatis; subtus sat pilosus; totus ferrugineus; antennis 9-articulatis, flabello perlongo (quam prothorax nullo modo breviori) arcuato 3-articulato; palpis maxillaribus sat elongatis, quam capitis inter oculos latitudo parum brevioribus; clypeo confertim vix subrugulose, fronte pronotoque crebre nec rugulose, subtilius punctulatis; prothorace quam longiori duplo latiori, antice haud fortiter angustato, mox ante basin setis elongatis fimbriato, lateribus leviter arcuatis, angulis anticis sat obtusis posticis obtusis subrotundatis, basi marginata utrinque sinuata; scutello fere lævi; elytris sat fortiter punctulato-striatis, striis haud geminatim ordinatis, interstitiis planis sat fortiter vix crebre punctulatis; pygidio fere ut pronotum, sed in media parte fere lævi, punctulato;

tibiis anticis extus tridentatis; tarsis posticis modicis, articulo basali quam 2us sat breviori; coxis posticis brevibus, metasterno duplo brevioribus; segmento ventrali apicali postice leviter emarginato. Long., 7 l.; lat., 3½ l.

Its large size, very long antennal flabellum, long maxillary palpi, and very short hind coxæ (scarcely half as long as the metasternum) render this species very distinct from its known congeners. None of these characters, however, appear to me to indicate generic distinctness.

New South Wales: Young. Given to me by Mr. Sloane.

P. inamœnus, sp. nov. Mas. Ovatus; sat nitidus; supra subglaber, lateribus ciliatus; subtus pilosus; totus ferrugineus; antennis 9-articulatis, flabello 3-articulato haud arcuato sat elongato (capiti longitudine sat æquali); palpis maxillaribus minus elongatis, quam capitis inter oculos latitudo multo brevioribus; capite crebre vix subrugulose minus subtiliter, pronoto subtilius minus crebre, punctulatis; prothorace quam longiori fere ut 5 ad 3 latiori, antice sat fortiter angustato, lateribus modice arcuatis, angulis anticis acutis posticis bene definitis obtusis, basi marginata utrinque sinuata; scutello fere lævi; elytris sat fortiter punctulato-striatis, striis haud geminatim ordinatis, interstitiis planis sat fortiter subcrebre punctulatis; pygidio sat crebre sat fortiter (sed in media parte fere lævi) punctulato; tibiis anticis extus tridentatis; tarsis posticis modicis, articulo basali quam 2us sat breviori; coxis posticis sat brevibus sed quam metasternum nullo modo duplo brevioribus; segmento ventrali apicali postice leviter emarginato. Long., 5 l.; lat., 2½ l.

An insect of unattractive appearance, not unlike the preceding *(P. major)* in respect of colouring and sculpture; but much smaller and with much shorter antennal flabellum (which is not curved), much shorter maxillary palpi, prothorax much less strongly transverse, etc., etc.

North Queensland. Sent to me by Mr. Sloane.

P. inusitatus, sp. nov. Mas. Ovatus; sat nitidus; supra subglaber, lateribus ciliatis; subtus pilosus; piceo-ferrugineus, antennis capite pronotoque obscurioribus; antennis 9-articulatis, flabello 4-articulato arcuato sat elongato (quam caput nonnihil longiori); palpis maxillaribus minus elongatis, quam capitis inter oculos latitudo multo brevioribus; capite confertim subrugulose minus subtiliter, pronoto fortiter sat crebre, punctulatis; prothorace quam longiori ut 4½ ad 3 latiori, antice sat fortiter angustato, lateribus modice arcuatis, angulis anticis acutis posticis obtusis, basi marginata utrinque sinuata; scutello

fere lævi; elytris fortiter punctulato-striatis, striis haud geminatim ordinatis, interstitiis convexis fortiter sat crebre punctulatis; pygidio sat crebre minus fortiter (sed in media parte fere lævi) punctulato; tibiis anticis extus tridentatis; tarsis posticis modicis, articulo basali quam 2us sat breviori; coxis posticis sat brevibus sed quam metasternum nullo modo duplo brevioribus; segmento ventrali apicali postice vix emarginato. Long., 5 l.; lat., $2\frac{2}{5}$ l.

The only *Platydesmus* known to me in which the antennal flabellum of the male consists of four joints. The alternate interstices of the elytra are a trifle wider than the other interstices but there is no real approximation to the kind of elytral sculpture that distinguishes the group of genera in which I have called the elytra "geminate-striate." The scutellum, as in some other species where I have used the term "*sublævi*," has only three or four punctures, generally near the base.

Queensland: Tambourine Mount. Sent to me by Mr. French.

Sericesthis.

S. (Scitala) suturalis, Macl. The unique type of this species in the Australian Museum is in very bad condition having lost its antennæ. There can however be no reasonable doubt of its being a true *Sericesthis* closely allied to *S. pruinosa*, Dalm. It is however a good species readily distinguishable from *pruinosa* by the pronotum at its hind angles expanded and distinctly upturned.

S. (Scitala) pruinosella, Brenske. I can find no mention of any character in the description of this species inconsistent with its being a later name for *S. suturalis*, Macl.

Neso.

I have to add another species to this genus. The following table shows the distinctive characters of the five species now known. The three species previously described by me differ considerably *inter se* in the antennal sexual characters. In *usta*, Blackb., the laminæ of the male are straight and about equal in length to the preceding joints together; in *yorkensis*, Blackb., the laminæ are distinctly longer and are curved; in *planicollis*, Blackb. [=*flavipennis (Platydesmus)*, Macl.] they are curved and still longer (well on to twice as long as the preceding joints together). In *usta*, moreover, the elytra are constantly,—so far as I have observed,—of a dark umber-brown colour,—in the other two, testaceous. The new species described below is not very close to the others, being much larger, with prothorax of different shape, pygi-

dium carinate (at least in the female), etc. *Scitala armaticeps*, Macl., is (as noted above under *Scitala)* a member of this genus, and the name *Scitala impressa*, Brenske, probably is also a name of the same insect. Having examined in the Macleay Museum the type of *Platydesmus flavipennis*, Macl., I am able to say that it also is a *Neso* and is identical with my *N. planicollis.*

A. A conspicuous transverse carina on the clypeus ... ... armaticeps, *Macl.*
AA. Clypeus not having a transverse carina.
  B. Hind angles of prothorax scarcely defined and very blunt. Size small.
    C. Elytral interstices in all respects uniformly punctulate ... ... usta, *Blackb.*
    CC. Alternate interstices of elytra not punctured uniformly with the other interstices.
      D. Pronotum quite strongly declivous behind ... ... yorkensis, *Blackb.*
      DD. Pronotum not declivous behind flavipennis *(Platydesmus), Macl.*
  BB. Hind angles of prothorax (viewed from above) well defined and almost right angles. Size large ... ... ducalis, *Blackb.*

N. ducalis, sp. nov. Fem. Ovata; subnitida; supra subglabra; subtus breviter pilosa; obscure ferruginea; antennis 9-articulatis, flabello 3-articulato quam articuli præcedentes conjuncti sat breviori; clypeo confertim rugulose, fronte sat crebre nec rugulose, minus fortiter punctulatis; prothorace quam longiori ut 7 ad 4 latiori, antice sat fortiter angustato, supra vix crebre minus fortiter punctulato, lateribus (superne visis) leviter arcuatis postice subparallelis, angulis anticis subacutis parum productis posticis (superne visis) fere rectis bene definitis, basi utrinque leviter sinuata ante scutellum subtiliter marginata; scutello fere lævi; elytris punctulato-striatis, striis manifeste geminatim ordinatis, interstitiis alternis haud (alternis leviter) convexis (alternis sat crebre, alternis minus crebre, punctulatis); pygidio longitudinaliter carinato, crebre fortiter sat rugulose punctulato; tibiis anticis extus tridentatis; tarsis posticis modicis sat robustis, articulo basali quam 2us nonnihil breviori; coxis posticis quam metasternum sat brevioribus; segmento ventrali apicali, postice subtruncato. Long., 7 l.; lat., 4 l.

This species, as noted above, is readily separated from its known congeners by its much larger sizes, differently-shaped prothorax, etc. The fine raised line on the basal margin of

the pronotum in front of the scutellum is very distinct in this species and is more or less distinctly traceable when looked for in all the other species of *Neso* that I have examined except in *N. usta*, Blackb., and the typical specimen of *N. armaticeps*, Macl.

North Queensland: Cairns. Sent by Mr. R. C. L. Perkins.

Sciton.

The species of this genus seem to be extremely rare in collections. The following new species is in the South Australian Museum.

S. variicollis, sp. nov. Fem. Leviter ovatus; sat elongatus; subopacus, nonnihil pruinosus; supra glaber; subtus parce pilosus; rufoferrugineus, antennarum flabello testaceo; capite confertim subtilius ruguloso, hoc inter oculos quam clypei margo anticus truncatus ut 4 ad 3 latiori; antennis 9-articulatis, flabello quam articuli 2-6 conjuncti breviori; prothorace quam longiori ut 7 ad 4 latiori, antice leviter angustato, supra subtilius sat crebre punctulato, postice sat fortiter declivi, lateribus (superne visis) leviter arcuatis, angulis anticis acutis minus productis posticis (superne visis) obtusis, basi marginata utrinque sinuata, scutello punctulato longitudinaliter leviter carinato; elytris geminato-striatis, interstitiis subfortiter sat crebre punctulatis (alternis angustis convexis); pygidio nitido crebre subtiliter punctulato; tibiis anticis extus tridentatis; tarsorum posticorum articulo basali quam 2us sat longiori, coxis posticis quam metasternum sat brevioribus; segmento ventrali apicali postice subtruncato. Long., $7\frac{1}{2}$ l.; lat., $3\frac{1}{2}$ l.

Resembles *S. ruber*, Blackb., from which it differs *inter alia* by its clypeus wider in front (in *ruber* the truncate front margin of the clypeus is very little more than half as wide as the interval between the eyes), its prothorax less transverse and less narrowed in front and strongly declivous behind, and the basal joint of its hind tarsi notably longer in proportion to the 2nd joint. Its very much larger size, as well as its clypeus wider in front, etc., readily distinguishes this species from *S. paullus*, Blackb.

Western Australia: Coolgardie.

Byrrhomorpha.

I have before me an undescribed species belonging to Mr. Lea which is certainly a member of this genus, although its inclusion therein involves the removal from the generic diagnosis of the words "labrum supra clypeum sursum productum." The genus, however, is abundantly distinct on ac-

count of other characters, and as the form of the labrum was not referred to in my tabulation of Australian *Sericoid* genera in placing *Byrrhomorpha*, the fact now indicated that that character is here (as in *Heteronyx*) not generic, will not introduce confusion into the use of the tabulation.

B. anomala, sp. nov. Ovatus; valde robusta; valde convexa; subnitida; subglabra; nigro-picea, antennis palpisque rufis; capite prothoraceque confertim rugulose sat fortiter punctulatis; antennis 9-articulatis, flabello 4-articulato, hujus laminis (exempli typici) articulis 2-5 conjunctis longitudine sat æqualibus; labro sat porrecto sed haud reflexo; clypeo profunde emarginato; prothorace quam longiori ut 7 ad $4\frac{1}{2}$ latiori, antice fortiter angustato, lateribus leviter arcuatis, angulis anticis acutis sat productis posticis (superne visis) rectis extrorsum subproductis, basi marginata utrinque leviter sinuata; scutello magno basin versus punctulato; elytris geminatim striatis, sat fortiter rugulose punctulatis, interstitiis alternis angustis sat lævibus; pygidio fere ut pronotum punctulato; tibiis anticis extus tridentatis; tarsorum posticorum articulo basali quam 2us paullo breviori; coxis posticis quam metasternum duplo brevioribus; segmento ventrali apicali postice sinuato. Long., $6\frac{1}{2}$ l.; lat., $3\frac{1}{2}$ l.

This species is of more elongate form than its described congeners, and differs notably from them both in the flabellum of its antennæ consisting of four laminæ. The sculpture of the elytra in this species resembles that of *B. ponderosa*, Blackb. except in the puncturation of the alternate (wide) interstices being much closer and much less coarse. I believe the specimen before me to be a female, judging from the form of its ventral segments. Among the comparatively few specimens that I have seen of the genus I do not find any strongly-marked characters likely to be sexual, and it is possible that I have seen only one sex.

New South Wales: Galston.

The following table shows distinctive characters of the three species now known.

A. Antennal flabellum consisting of only three laminæ.	
B. All the elytral interstices decidedly, and about equally, convex. Size small	verres, *Blackb.*
BB. Only the alternate narrow interstices of the elytra convex. Size much larger	ponderosa, *Blackb.*
AA. Antennal flabellum consisting of four laminæ	anomala, *Blackb.*

It will be well to add, here, a note that *Scitala pallidula*, Macl. (of which I have recently examined the type) might

perhaps by my tabulation of the Australian *Sericoid* genera be referred to *Byrrhomorpha*, on account of its clypeus being lightly emarginate across the front. *S. pallidula* is, as indicated above, an isolated form which may prove, when its sexes are known, to require the formation of a new genus (as Macleay forecasted). It is, however, very far removed from *Byrrhomorpha* which is a genus of extremely robust coarsely sculptured insects with hind tibiæ very stout and strongly dilated at their apex; while *S. pallidula* is altogether of the *Scitala* build,—of fragile form and having hind tibiæ elongate slender and almost without apical dilatation.

Ocnodus.

The presence of conspicuous tufts of hairs on the under surface of the tarsal joints seems to be the most noticeable character of this genus. The extremely short hind coxæ also furnish a noteworthy character. The antennal structure, judged by the species as yet known, seems to be uniform—which is very unusual in the Australian *Sericoides*. The structure of the labrum is extremely variable and furnishes a valuable specific character. The form of the hind angles of the prothorax is most remarkable. In all the species known to me these angles are really obtuse or subrectangular, but owing to the curve of the convexity on the dorsal surface (except perhaps in *O. lugubris*, Blackb.), they appear acute or even spiniform if the prothorax be looked down upon from directly above it. I have now three additional species before me which are described below. The following table shows characters by which the species known may be distinguished.

It is possible that some of the insufficiently-described species of the early authors (discussed by me under the heading of *Scitala*, &c.) may be attributable to this genus, but I think it improbable, as the genus is not known to occur in the localities where most of the species in question were found.

When I described the *Coleoptera* of the Elder Expedition I attributed to this genus with a strong expression of doubt a species which I described under the name *ferrugineus*. I am now satisfied that it must not remain associated with the other species referred by me to *Ocnodus*, and that its real affinities are with *Caulobius*, under which generic name I have already recorded it (above) in this memoir.

I must here repeat what I have already notified, viz., that since I have never succeeded in identifying the typical species of *Ocnodus* (*O. decipiens*, Burm.) there is a doubt whether the species to which I have applied the name *Ocnodus* are really congeneric with Burmeister's insect. It will be well to remember that the generic position of those species will be best expressed by calling them *Ocnodus*, Blackb. (?Burm.).

A. Elytra non-setose.
  B.* Labrum small, scarcely projecting from front face of head, its summit very distant from summit of front face of head.
    C. Basal edging of pronotum very distinctly thickened and more elevated at its ends.
      D. Clypeus evenly rounded in front — fallax, *Blackb.*
      DD. Clypeus truncate in front ... — lepidus, *Blackb.*
    CC. Basal edging of pronotum uniformly fine ... ... — lugubris, *Blackb.*
  BB. Labrum much larger, distinctly prominent, its summit not much below summit of front face of head.
    C. Clypeus in front widely and very feebly emarginate.
      D. Basal declivity of pronotum nitid and almost punctureless (a row of punctures close to basal edging) ... ... — suspiciosus, *Blackb.*
      DD. Basal declivity of pronotum punctured scarcely differently from the rest of the surface ... — spinicollis, *Blackb.*
    CC. Clypeus in front deeply angularly emarginate ... ... — scissiceps, *Blackb.*
  BBB. Labrum (viewed from above) scarcely prominent, but its summit near summit of front face of head — porosus, *Blackb.*
AA. Elytra setose ... ... — decipiens, *Burm.*

O. lepidus, Blackb. I have recently received two female specimens of *Ocnodus* taken by Mr. Perkins in Queensland, which I regard with some hesitation as this species, of which the male only was previously known. They are somewhat larger (long. 6 l.) than I should expect the female of *lepidus* to be and are considerably less nitid than the male, with the dorsal puncturation a trifle stronger and the hind angles of the prothorax slightly less obtuse, so that from a certain point of view (looked at obliquely across the insect) they appear more sharply subdentiform than those angles appear in *lepidus* (male) from a similar point of view. Moreover the hind tarsi are evidently stouter (which is not likely, I think, to be a female sexual character). It is quite possible, therefore, that they represent a distinct closely allied species.

O. lugubris, Blackb. At the time when I described this species I regarded my specimens as females, but I have now no doubt that one of them is a male. Its sexual characters, however, are very slight, consisting in considerably greater stoutness of the front tarsi, less convexity of the ventral segments, and a difference in the pygidium—which is perpendicular in the female but inclined inward in the male so that

* For notes on labrum *vide infra O. porosus*, sp. nov.

its apex seems to push a little into the apical ventral segment.

O. suspiciosus, sp. nov. Mas. Ovalis; sat nitidus; subglaber; piceus, antennis palpisque testaceis; illis 9-articulatis, flabello 3-articulato quam articuli præcedentes 5 subbreviori; labro magno producto profunde emarginato; clypeo crebre fortiter subrugulose punctulato, antice late leviter emarginato, fronte fortiter minus crebre nec rugulose punctulato; prothorace quam longiori fere duplo latiori, antice parum angustato, supra fortiter inæqualiter vix crebre punctulato, basin versus fere lævi, lateribus leviter sinuatim arcuatis, angulis anticis subacutis parum productis posticis (superne visis) acutis subdentiformibus, basi marginata utrinque sinuata; scutello punctulato; elytris fortiter sat crebre subseriatim punctulatis; pygidio crebre sat grosse punctulato; tibiis anticis extus fere inermibus; tarsis anticis quam tibiæ multo longioribus, posticorum articulo basali quam 2us sublongiori; coxis posticis quam metasternum fere triplo brevioribus; segmento ventrali apicali postice late leviter emarginato; corpore subtus fortiter punctulato. Long., 4½ l; lat., 2 l.

The elytral puncturation gives a slight suggestion of geminate arrangement in the form of pairs of rows of punctures slightly more regularly seriate than the intermediate rows (about three in number) which occupy the intervals between those pairs. This species is somewhat close to *O. spinicollis*, Blackb. It is smaller and in all parts somewhat less strongly punctulate, the pronotum almost punctureless immediately in front of the base, the hind angles of the pronotum less dentiform, the clypeus in front less widely and a little more strongly emarginate, the external margin of the front tibia with only a single feeble projection above (and close to) the apical projection (in *spinicollis* there are two strong teeth above the apical projection), the pygidium non-carinate. It is possible that some few of the above distinctions may be sexual rather than specific and may be absent in the female of *O. suspiciosus*, but that is not likely since I do not find them distinguishing the sexes in *O. lugubris*,—the only species of the genus of which I am confident that I have seen both sexes.

Western Australia: Perth. Sent by Mr. Hamilton.

O. scissiceps, sp. nov. Mas. Breviter ovalis; minus nitidus; subglaber; rufopiceus, antennis palpisque nonnihil dilutioribus; illis 9-articulatis, flabello 3-articulato quam articuli præcedentes 5 conjuncti manifeste breviori; labro magno producto, profunde bilobo, lobis (superne visis) subspiniformibus; clypeo antice profunde angulatim

emarginato, cum fronte confertim fortiter ruguloso; prothorace quam longiori duplo latiori, antice quam postice haud angustiori, supra confertim subtilius punctulato, lateribus (superne visis) leviter sinuatim arcuatis angulis anticis acutis sat productis posticis (superne visis) sat acute rectis, basi marginata utrinque parum sinuata; scutello crebre sat subtiliter punctulato; elytris crebre sat subtiliter (hic et illic subseriatim) punctulatis; pygidio pernitido, grosse crebrius punctulato, obsolete carinato; tibiis anticis extus minus perspicue dentatis; tarsis anticis quam tibiæ paullo longioribus, posticorum articulo basali quam 2us vix longiori; coxis posticis quam metasternum plus quam duplo brevioribus; segmento ventrali apicali per pygidium (hoc subtus flexo) profunde emarginato; corpore subtus fortiter punctulato. Long., $4\frac{1}{2}$ l.; lat., $2\frac{1}{5}$ l.

The pygidium strongly bent under the body and causing the apical ventral segment to be strongly emarginate seems to indicate the unique specimen before me of this insect to be certainly a male. In the other males known to me of the genus a similar structure is slightly discernible (as compared with the structure of the same parts in the specimens which I judge to be females of the genus). I have not found in it any other character likely to be sexual on account of its being common to the other males and not to the females known to me of the genus. There is an almost obsolete blunt tooth on the external margin of the front tibiæ slightly above the apical projection. The elytra present slight indications of geminate sculpture in a tendency of the punctures to fall into pairs of traceable rows,—the pairs being separated by intervals in which there is no trace of seriate arrangement, but this character in the sculpture needs to be looked for, being very inconspicuous. The species is very isolated among its congeners by many characters,—form of labrum and clypeus, comparatively fine puncturation of dorsal surface, etc.

Western Australia: Coolgardie. Taken, I believe, by my son.

O. porosus, sp. nov. Breviter late ovalis; sat nitidus; subglaber; piceo-niger, antennis palpisque rufis; illis 9-articulatis, flabello 3-articulato quam articuli præcedentes 5 conjuncti manifeste breviori; labro sat magno parum producto (hujus altitudine quam clypei frontis pars supra majori); clypeo antice rotundato, cum fronte grosse sat crebre punctulato; prothorace quam longiori duplo latiori, antice parum angustato, supra sparsim sat grosse punctulato, lateribus (superne visis) leviter sinuatim

arcuatis, angulis anticis acutis sat productis posticis (superne visis) sat acute dentiformibus, basi marginata utrinque sinuata; scutello basin versus punctulato; elytris grosse subseriatim minus crebre punctulatis, stria subsuturali sat perspicua; pygidio grosse sat crebre punctulato: tibiis anticis extus tridentatis: tarsis antícis quam tibiæ vix longioribus, posticorum articulo basali quam 2us vix longiori: coxis posticis quam metasternum fere triplo brevioribus: segmento ventrali apicali postice haud emarginato: corpore subtus grosse punctulato. Long, $3\frac{1}{2}$ l.; lat., $1\frac{4}{5}$ l.

The labrum resembles that of *O. fallax*, etc., in respect of its only slight projection from the perpendicular front face of the head but differs by its much larger size which may be expressed as follows:—Looking (from in front) at the front face of the head one sees the outline of the clypeus as an arc of a circle the altitude of which is evidently greater than the distance from the vertex of the labrum to the vertex of the perpendicular front face of the head, while in *fallax*, etc., the corresponding altitude occupies a very much smaller proportion of the front face of the head. The extremely coarse puncturation of the dorsal surface prevents the confusion of this species with any other *Ocnodus* known to me.

Western Australia: Yilgarn.

Diphyllocera.

D. kirbyana, White. Burmeister has drawn attention to the fact that the antennal flabellum of this species consists of five lamellæ according to White and of six according to Erickson. In the male there are six lamellæ of about equal length, while in the female the basal lamella is so short that its being in reality a joint of the flabellum might easily be overlooked. As White describes the male it is clear that he either counted incorrectly or had before him a species unknown to subsequent authors and distinct from that which has since borne the name *kirbyana*.

Pachygastra.

In my tabulation of the Australian *Sericoid* genera *(loc. cit.)* this genus is distinguished by the form of its front tibiæ. It should be noted that I have described, above, a new species under the name *calorata* having front tibiæ not much different from those of *Pachygastra* but which certainly cannot be regarded as a member of that genus. I have placed it in *Frenchella*.

Mæchidius.

M. raucus, sp. nov. Late ovatus; minus convexus; minus

nitidus; piceo-niger, antennis palpisque rufis; setulis brevibus subtilibus sat crebre vestitus; capite antice sat profunde subangulatim emarginato (partis emarginatæ lobis antice rotundatis), lateribus sinuatis; prothorace quam longiori fere ut 5 ad 3 latiori, antice sat fortiter angustato, supra crebre fortiter ruguloso, lateribus crenulatis fortiter dilatato-rotundatis ante basin brevissime rectis, angulis anticis sat productis sat acutis posticis acute rectis, basi late rotundata; scutello punctulato; elytris striis circiter 9 impressis, interstitiis latis inæqualiter biseriatim granulosis, interstitiis alternis manifeste convexis; tibiis anticis extus tridentatis (dentibus inferioribus approximatis, a 3° sat remotis); tarsis robustis sat brevibus, posticorum articulo basali quam 2us paullo longiori; unguiculis singulis ad basin appendiculis singulis gracilibus armatis. Long., 5 l.; lat., $2\frac{3}{4}$ l.

The form of the outline of the prothorax of this species is very distinctive, the nearest approach to it, in *Mœchidii* known to me, being found in *M. crenaticollis*, Blackb. The sides of the prothorax are extremely strongly dilatate-rounded from the front margin almost to the base, but immediately in front of the base they become quite straight (and parallel with each other). The above-mentioned character (together with other characters) places the insect in my tabulation (Tr.R.S., S.A., 1898, pp. 57, etc.) beside *M. caviceps* although the sides of the prothorax in that species are not sinuate behind the middle, the hind angles are obtuse, and there is very little superficial resemblance between the two. From *crenaticollis*, to which it has much superficial resemblance, it differs *inter alia* by the presence of quill-like appendages to its claws.

Victoria: Dividing Range.

M. relictus, sp. nov. Leviter ovatus; minus latus; sat convexus; sat nitidus; ferrugineus; setulis brevibus subtilibus minus crebre vestitus; capite antice sat profunde emarginato (partis emarginatæ lobis antice rotundatis), lateribus manifeste sinuatis; prothorace quam longiori fere duplo latiori, antice sat fortiter angustato, supra puncturis sat magnis mamillatis sat crebre impresso, lateribus haud crenulatis sat arcuatis, angulis anticis sat productis minus acutis posticis rotundato-obtusis, basi utrinque sinuata; scutello punctulato; elytris inæqualiter sculpturatis (in parte dorsali intervallis circiter 5 leviter convexis sat latis utrinque sat grosse punctulato-crenulatis, in parte laterali sat confuse crenulato-punctulatis); tibiis anticis extus tridentatis (dentibus inferioribus inter se approximatis a 3°,—hoc in longitudine media sito,—

sat remotis); tarsorum posticorum articulo basali quam 2us sat longiori; unguiculis singulis ad basin appendiculis singulis gracilibus armatis. Long., 3 l.; lat., $1\frac{3}{4}$ l.

In my tabulation of the species of *Mœchidius (loc. cit.)* this species must be placed beside *M. caviceps*, Blackb., from which it differs by, *inter alia*, its clypeus considerably less deeply excised with the lobes of the excision rounded (not externally angulate) in front, and by its elytral sculpture [which in *caviceps*, Blackb. consists of about 18 striæ,—the lateral ones scarcely defined,—the interstices scarcely and *inter se* subequally convex and obscurely seriate-granulate; while in *relictus* the elytra cannot be called distinctly striate the sculpture consisting of rows of punctures (some of them moderately, others very, large) among which are about 5 irregular distinctly elevated intervals having their sides strongly crenulate by the adjacent punctures]. In my original description of *M. caviceps* I did not mention the granulation of the elytral interstices. The granules are small and inconspicuous (less so on the sides and apical parts of the insect) and were concealed by a thin indumentum which I find was present on the typical specimen in the S.A. Museum; but inspection of the elytral interstices of a second example recently acquired by me shows the presence of fine granules.

North Queensland. Taken by Mr. Perkins.

M. capitalis, sp. nov. Breviter ovatus, sat convexus; subnitidus; obscure ferrugineus, antennis palpisque dilutioribus; setulis brevibus subtilibus minus crebre vestitus; capite antice obtuse truncato, lateribus vix sinuatis; prothorace gibbo, leviter transverso, antice fortiter angustato, supra confertim sat fortiter ruguloso, lateribus subcrenulatis sat arcuatis pone angulos posticos (his subrectis) excisis, angulis anticis minus productis minus acutis, basi late rotundata; scutello magno punctulato; elytris striis circiter 9 sat latis impressis, interstitiis sat latis sat planis (his utrinque punctulato-crenulatis); tibiis anticis (exempli typici) extus sinuatis haud perspicue dentatis; tibiis posterioribus 4 in parte media dente instructis (ut *M. tibialis*, Blackb.); tarsis posticis brevibus, posticorum articulo basali quam 2us vix longiori; unguiculis simplicibus. Long., 4 l.; lat., $2\frac{1}{5}$ l.

In my tabulation of the species of *Mœchidius (loc. cit.)* this species must be placed beside *M. rugosipes*, Blackb., from which it differs by *inter alia* its clypeus truncate in front and its prothorax scarcely transverse. Its short robust posterior tibiæ with their external face transversely carinate at about the middle of their length so that the outline appears strongly

dentate in the middle distinguish this species at once from all other *Mæchidii* known to me except *tibialis*, Blackb., and *rugosipes*, Blackb.

Western Australia: Gnarlbine. Given to me by Mr. French.

DYNASTIDES.

Pimelopus.

P. porcellus, Er. A specimen taken on King Island must certainly, I think, be attributed to this species. It agrees with Erickson's description except in size,—being considerably smaller than the type,—and in the prothorax being considerably (not "scarcely") narrowed in front. The size is of little importance, since other species of the genus vary greatly in this respect; and I am of opinion that Erickson was in error in respect of the prothorax. In all the *Pimelopi* known to me the actual front margin, owing to the front part of the pronotum being very strongly declivous is not in sight from certain points of view, and it is easy to place a specimen so that the prothorax appears to be wide in front; but if the prothorax be examined with the head towards the observer the front margin is seen to be in reality much narrower than the base. I cannot help thinking that this accounts for the discrepancy between the King Island example and the description of *P. porcellus*. If the front margin of the prothorax were really "scarcely" narrower than the base *P. porcellus* would, I think, stand alone in this respect among the Australian *Dynastides*,—with the exception of a few species of the very aberrant genus *Cryptodus*. The examination of a specimen so likely (on the ground of its habitat) to be the true *P. porcellus* is of interest on account of my having (Tr.R.S., S.A., 1887, p. 220) described as "*P. porcellus*, Er. (?)" a species that is certainly not identical with this King Island specimen. For this South Australian species I now propose the name *decipiens*. Its female differs from the King Island example (which is a female, as also was Erickson's type) principally in the shape of the prothorax, which is very strongly bisinuate at the base, so that the middle part appears as a very well-defined lobe; while in the King Island example the bisinuation is very feeble making the base appear as an almost continuous curve. The basal impressions of the pronotum are in *decipiens* strongly marked and in the King Island example very feeble. The striation of the elytra is notably stronger in *decipiens*.

The King Island specimen resembles *P. dubius*, Blackb. in the form of the prothorax. And here I must call attention to an unfortunate oversight in my description of the

latter species; for I passed over the description of the prothorax with the remark that that segment scarcely differed from the same in "*porcellus (?)*." At the time I had in mind other distinctions which are very strongly marked between the two species and overlooked the less conspicuous (but certainly quite obvious when attention is drawn to it) difference in the basal outline of the prothorax.

The King Island specimen agrees with *P. dubius* in having only a single transverse carina on the external face of the middle and hind tibiæ but differs from it (and agrees with *decipiens)* in the robust posteriorly-swollen form of its elytra, —which is, I suppose, what Erickson refers to when he calls the elytra of *porcellus* "ventricosa."

From the above remarks it appears so evident that the true *P. porcellus*, Er. (at any rate this species from King Island) is intermediate in structure between *P. decipiens* and *P. dubius* that there need be no further hesitation in associating those species generically. As the specimen from King Island does not fit well into the tabulation of specific characters of *Pimelopi* which I furnished in Tr.R.S., S.A., 1896, p. 256, it will be well to substitute the following tabulation: —

A. Posterior tibiæ unicarinate externally.	
B. Base of prothorax subbisinuate.	
C. Elytra strongly and subrugulosely punctulate and swollen behind ...	porcellus, *Er.*
CC. Elytra very feebly and sparsely punctulate and subparallel ...	dubius, *Blackb.*
BB. Base of prothorax very strongly bisinuate	sydneyanus, *Blackb.*
AA. Posterior tibiæ bicarinate externally.	
B. Elytral puncturation obsolete on lateral and subapical parts	crassus, *Blackb.*
BB. Elytral puncturation continuous ...	decipiens, *Blackb.*

P. decipiens, sp. nov. This name is proposed for *P. porcellus*, Er. (?), Blackb., Tr.R.S., S.A., 1887, p. 220.

P. dubius, Blackb. For amendment of original description *vide supra* under heading *P. porcellus*, Er.

CISSIDÆ.

Cis.

C. leanus, sp. nov. Minus latus; vix pubescens; sat nitidus; supra brunneo-testaceus, pronoto antice sat late et in lateribus anguste elytris in sutura et latera versus incerte infuscatis; capite sat crebre minus subtiliter nec rugulose, pronoto confertim fortiter sat rugulose, elytris quam pronotum paullo minus crebre nec rugulose, punctulatis; his circa scutellum subgibbis; antennis pedibusque testaceis, horum femoribus illarum clava infuscatis; corpore subtus

(capite et prosterni lateribus exceptis) piceo, sat grosse nec profunde punctulato. Long., $\frac{4}{5}-1$ l.; lat. $\frac{3}{10}$ l.

Easily distinguishable from the other described Australian species of the genus by its colouring and its comparatively coarse puncturation. The prothorax is rather strongly transverse,—more so than in its Australian congeners (except perhaps *C. Adelaidæ*, Blackb., which approaches it in this respect) and is very little produced over the head. Of the two examples before me, one (doubtless the male) has an evident though slight gibbosity in the middle of the forehead, while the forehead of the other is very flat.

TENEBRIONIDÆ.

Hopatrides.

Herr Gebien has recently called my attention to the fact that Reitter last year, in Verh. ver., Brunn, founded a new genus of *Tenebrionidæ* under the name *Mesomorphus*, to which some of the Australian species hitherto placed in *Hopatrum* must be transferred. These species are distinguished from true *Hopatra* by the different vestiture of their tarsi, the obliteration of the clypeal suture, and their divided eyes. Champion had already noted the existence of this aggregate as a section of *Hopatrum* possibly needing to be separated generically (Tr.E.S., Lond., 1894, p. 361), and I had myself at a still earlier date (1892) mentioned the first of them that I had seen as probably needing a new generic name. Unfortunately *Mesomorphus* is a *nom. præocc.*, having been used by Pratz in 1883 *(Mesomorpha)*. As the species in question appear to me to be certainly generically distinct from *Hopatrum* I propose to give them a new genus under the name *Hopatromorpha*, which I cannot ascertain to have been used previously.

Hopatrum.

I have before me two new species of this genus, and have recently inspected the type of *H. Mastersi*, Macl. I propose before describing the new species to furnish a tabulated statement of the characters by which the species of *Hopatrum* may be distinguished *inter se*. After the removal of the species already referred to as not genuine *Hopatra* there remain ten names that seem attributable to Australian species of the genus, one of which *(H. australe*, Boisd.), I must pass over on account of its being, as Champion has already pointed out, not intelligibly described. The addition of my two new species therefore bring up the number to eleven. I have before me authentic specimens of all except one *(H. torridum*, Champ.), and I have a *Hopatrum* from north-west

Australia agreeing so well with the description of *H. torridum* that I am fairly confident of having identified it correctly.

Before proceeding to the tabulation it is desirable to furnish a note on one of the group characters that will be mentioned in it, viz., "Elytral intersices unequal." In the species to which that expression applies the 3rd and 5th interstices (especially the 3rd) are distinctly more convex than the 2nd and 4th, and the 2nd and 4th (especially the 2nd) are narrower (*very much* narrower in the hinder part) than the 3rd and 5th. In the rest of the species the interstices are uniform in respect of convexity, and there is no great diversity in respect of width.

A. Elytra entirely striate.
  B. Elytral interstices unequal.
    C. Sides of prothorax more or less sinuate behind middle, hind angles acute.
      D. Joint 8 of antennæ twice as wide as long ... ... Mastersi, *Macl.*
      DD. Joint 8 of antennæ less than twice as wide as long.
        E. Elytral interstices with conspicuous well-defined granules Walkeri, *Champ.*
        EE. Elytral interstices closely rugulose, not granulate ... Carpentariæ, *Blackb.*
    CC. Sides of prothorax absolutely non-sinuate, hind angles blunt ... Macleayi, *Blackb.*
  BB. Elytral interstices uniform—at most a little diversity in width.
    C. Sides of prothorax not sinuate behind middle.
      D. Prothorax at its widest across base.
        E. Front of clypeus with a deep angular emargination.
          F. Front tibiæ stout and very strongly dilated at apex ... Meyricki, *Blackb.*
          FF. Front tibiæ slender, very feebly dilated at apex ... Elderi, *Blackb.*
        EE. Front of clypeus with a shallow arched emargination ... Victoriæ, *Blackb.*
      DD. Prothorax notably wider about middle than across base ... misellum, *Blackb.*
    CC. Sides of prothorax quite conspicuously sinuate behind middle torridum, *Champ.(?)*
AA. Each elytron with only two strong striæ, the outer striæ obsolete ... Adelaidæ, *Blackb.*
AAA. Elytra without defined striation ... cowardense, *Blackb.*

H. Mastersi, Macl. This species is near *Walkeri*, Champ., and *Carpentariæ*, Blackb. It is identical with a *Hopatrum* sent by Mr. Perkins which (before I saw *Mastersi)* I had intended to describe as new. It is easily separated from *Walkeri* by, *inter alia*, the non-granulate interstices of its elytra.

From *Carpentariæ* it differs by, *inter alia*, the much stronger sinuation of the hind part of the sides of the prothorax and the 8th joint of its antennæ considerably more transverse.

H. Macleayi, sp. nov. Minus latum; sat opacum; piceo-nigrum, setis brevissimis vestitum; supra confertim subtilius rugulosum; clypeo a fronte discreto, antice triangulariter emarginato; oculis haud divisis; antennis modicis, articulis 8-10 sat fortiter transversis; prothorace quam longiori duplo latiori, lateribus sat fortiter explanatis sat rotundatis pone medium nullo modo sinuatis, angulis anticis minus productis minus acutis (posticis minus productis rectis), latitudine majori vix pone medium posita; elytris quam prothorax paullo latioribus, sat æqualiter sat fortiter striatis, striis quam interstitia multo magis fortiter punctulatis (illarum puncturis, præsertim postice, costulis minus perspicuis conjunctis), interstitiis convexis (3°, 5°, 7° que quam cetera manifeste magis elevatis postice latioribus); tibiis anticis a basi ad apicem sat fortiter dilatatis, angulo externo apicali sat acuto. Long., 4 l.; lat., 2 l.

The form of the prothorax seems to be the most conspicuous character of this species; the rounded sides of that segment distinctly converging from a little behind the middle to the base, but without the slightest sinuation, with front angles almost obtuse and hind corners scarcely sharply right angled, are very distinctive. The only other described species known to me with the 3rd, 5th, and 7th interstices of the elytra so strongly defined is *Walkeri*, Champ., which differs widely in the form of its prothorax.

Queensland: Toowoomba (Koebele).

H. misellum, sp. nov. Minus latum; sat opacum; piceo-nigrum; setis brevissimis vestitum; supra sat æqualiter crebre minus subtiliter rugulosum, vix granulosum; clypeo a fronte discreto, antice triangulariter emarginato; oculis haud divisis; antennis modicis, articulis 8-10 fortiter transversis; prothorace quam longiori plus quam duplo latiori, lateribus modice explanatis minus arcuatis pone medium haud sinuatis, angulis anticis acutis posticis (superne visis) acute rectis, basi media leviter emarginata, latitudine majori paullo ante basin posita; elytris quam prothorax paullo latioribus, æqualiter sat profunde striatis, striis quam interstitia multo magis fortiter punctulatis, interstitiis convexis; tibiis anticis a basi ad apicem sat fortiter dilatatis, angulo externo apicali acuto. Long., $4\frac{1}{4}$-5 l.; lat., 2-2 $\frac{1}{10}$ l.

I conjecture this to be the species mentioned by Champion (Tr.E.S. 1894, p. 359) as "perhaps" *O. villiger*, Blanch., as it is the only *Hopatrum* that I have found in the neighbourhood of Port Adelaide (Champion's locality). However that may be, it is I think certainly not *H. villiger*, the elytral striæ of which are described as "without puncturation," and which moreover is said to be from "Raffles Bay" a locality on the north coast of Australia. It is nearer I think to the species that I have no doubt is *H. torridum*, Champ., than to any other described *Hopatrum*, but is readily distinguishable from it by, *inter alia*, the evidently convex interstices of its elytra, and its less opaque dorsal surface.

South Australia (widely distributed).

HOPATROMORPHA.

(Gen. nov. *Tenebrionidarum*; = *Mesomorphus*, Reitter, *nom. præocc.*)

Australian species of this genus have been described, I believe, under six names. The first of them is *Hopatrum villiger*, Blanch., the description of which points to its place being here. I have received, moreover, from Herr Gebien a specimen under that name which is undoubtedly a member of this genus, and it agrees fairly well with Blanchard's description. In 1892 I described a second species under the name *Hopatrum longicorne* (from Central Australia). In 1894 Champion described two species (*Hopatrum dispersum* and *vagabundum*) in the Tr.E.S., Lond., and I described (published a few months later than Champion's names) two species (*H. darlingense* and *Darwini*). The species sent by Gebien as *villiger*, Blanch., is identical with that sent to me by its author as *dispersum*, Champ. *Dispersum* is from Port Darwin; *villiger* was described from Raffles Bay; two adjacent localities. Neither *darlingense* nor *Darwini* appears to be identical with either of Champion's species, although *vagabundum* and *Darwini* are probably somewhat close to each other. I have already (Tr.R.S., S.A., 1894, p. 218) pointed out distinctions between the two,—the former of which I have not seen and I may now add the further note that Champion calls joints 9 and 10 of the antennæ of *vagabundum* "transverse" (without qualification) whereas those joints in *Darwini* are "vix transversis" (unfortunately printed in my description "vix convexis"), and moreover the seriate elytral punctures of *Darwini* are so conspicuously very much larger than those of *dispersum*, Champ. (which indeed are almost non-existent) that Champion could not possibly have failed to refer to that distinction in differentiating *vagabundum* from *dispersum* if *vagabundum* had been my *Darwini*.

J

The following table shows the characters which seem to me most conveniently to be used for distinguishing *inter se* the species of this genus.

A. Prothorax strongly transverse (about twice as wide as long).	
B. Ocular canthi wide (as wide as the eye, at least in *Darwini*).	
C. Elytral interstices granulate. Joints 9 and 10 of antennæ transverse	vagabunda, *Champ.*
CC. Elytral interstices non-granulate. Joints 9 and 10 of antennæ not distinctly transverse	Darwini, *Blackb.*
BB. Ocular canthi much narrower ...	dispersa, *Champ.* villigera, *Blanch. (?)*
AA. Prothorax less transverse (about as 5 to 3).	
B. Elytral striæ quite strongly impressed	darlingensis, *Blackb.*
BB. Elytral striæ scarcely impressed (almost mere rows of faint punctures)	longicornis, *Blackb.*

H. darlingensis, Blackb. Specimens of this insect have been sent to me by Mr. Carter, of Sydney. He writes that they were sent to him by Judge Docker of Walgett, who reported the insect as occurring in great plenty in his neighbourhood. This is to me an interesting note, as I had previously seen only two examples of the species.

HELÆIDES.

Pterohelæus.

I have several interesting new species of *Pterohelæus* recently acquired in my collection appertaining to the group which Macleay in his monograph of the genus calls the 2nd subsection of the 2nd section, characterized thus:—"Form more elongate; elytra seriate-punctate, their interstices granulose." It seems desirable to make the opportunity of describing them an occasion for a revision of the group and for placing in tabular form an indication of the distinctive characters of its species. Macleay's monograph supplies merely descriptions of seven species without any tabular arrangement, while an eighth species (*P. squalidus*) decidedly belonging to this subsection is attributed to the preceding one with a note that it is perhaps wrongly placed. Since Macleay's monograph was published I have described a single species (*insignis*) of this subsection. Three species of *Pterohelæus* have been described by Lea, but without information as to which of Macleay's aggregates they appertain to; as, however, the descriptions contain no mention of elytral granules it is presumable that they are not members of the sub-

section that I am now dealing with. At the present time, then, species attributable to this aggregate have been described under nine names. Of these nine names one (*P. Guerini*, Brême) cannot be confidently identified with any insect by the description, which however (such as it is) would fit *P. tristis*, Germ., fairly well. (Germar's the later name.)

The following table shows characters by which the *Pterohelæi* of this group can be distinguished *inter se*, with the exception of *P. Guerini*, Brême, concerning which there is not sufficient information available for its inclusion:—

A. Joint 6 of antennæ not or but little dilated on outer margin, never decidedly transverse.
  B. Alternate striæ of elytra much deeper than the other striæ ... ... insignis, *Blackb.*
  BB. Elytra not having alternate striæ deeper than the rest.
    C. Elytra much more nitid than CC.
      D. Lateral margins of pronotum very feebly explanate ... ... simplicicollis, *Blackb.*
      DD. Lateral margins of pronotum strongly explanate.
        E. At least all the alternate interstices of elytra conspicuously and regularly granulate.
          F. Prothorax twice as wide at base as in front. Size large granuliger, *Macl.*
          FF. Prothorax much less narrowed in front. Size moderate ... ... regularis, *Blackb.*
        EE. Front and inner parts of elytra not (or only sparsely) granulate.
          F. Pronotum sparsely and faintly punctulate.
            G. Size large. Surface only moderately nitid. Lateral area of pronotum wide and flat ... ... tristis, *Germ.*
            GG. Size small. Surface quite nitid. Lateral area of pronotum narrower and concave ... ... nitidiusculus, *Macl.*
          FF. Pronotum closely and strongly, though finely, punctulate ... ... gracilicornis, *Blackb.*
    CC. Elytra notably more opaque.
      D. Explanate margin of elytra wide (at base as wide as apex of front tibia) ... ... granulatus, *Germ.*
      DD. Explanate margins of elytra much narrower.
        E. Ventral segments with scarcely any trace of longitudinal wrinkles ... ... ventralis, *Blackb.*

EE. Ventral segments with plentiful longitudinal wrinkles ... subgeminatus, *Macl.*

AA. Joint 6 of antennæ strongly dilated on outer margin, transverse.

B. Disc of pronotum conspicuously granulate-rugulose ... ... squalidus, *Macl.*

BB. Disc of pronotum not granulate-rugulose.

C. Front of pronotum very feebly emarginate, and having rounded very feeble angles ... ... bullatus, *Pasc.*

CC. Front of pronotum much more emarginate, with prominent angles (as in *granulatus*, Germ.).

D. Width of prothorax considerably more than twice length ... brevicornis, *Blackb.*

DD. Width of prothorax scarcely twice length ... ... puer, *Blackb.*

P. simplicicollis, sp. nov. Sat parallelus; subnitidus; sat convexus; nigro-piceus, marginibus antennis palpis pedibusque rufescentibus; antennis modicis (articulis 6° quam latior longiori extus haud dilatato, 7°-10° transversis extus fortiter dilatatis); capite crebre subtiliter, prothorace supra vix manifeste, punctulatis; hoc quam longior plus (quam trans apicem vix plus) quam duplo latiori, supra vix manifeste canaliculato, marginibus lateralibus minus latis a disco parum discretis, margine antico sat late minus fortiter emarginato, angulis anticis sat rotundatis posticis valde acutis: elytris seriatim subfortiter punctulatis, interstitiis alternis granulis nitidis (his antice perparvis, apicem versus gradatim multo majoribus) ornatis, margine laterali angusto (quam *P. granulati*, Germ., multo angustiori); corpore subtus sat nitido; abdomine latera versus strigato. Long., 7 l.; lat., $3\frac{1}{2}$ l.

Remarkable for the expanded margins of its pronotum being narrower and less clearly distinguishable from the disc than is usual among its allies. The expanded margin of its elytra also is very narrow, much narrower than in, *e.g.*, *P. bullatus*, Pasc. The shining granules form complete rows on the alternate interstices of the elytra, but they are extremely minute on the front part and even more so near the suture than near the lateral margins.

South Australia; Eyre Peninsula. Taken by the late Mr. J. Anderson.

P. regularis, sp. nov. Sat parallelus; minus opacus; modice convexus; nigro-piceus, marginibus antennis palpis pedibusque rufescentibus; antennis modicis (articulis 6° vix transverso extus vix dilatato, 7°-10° sat transversis extus fortiter dilatatis); capite crebre subtiliter, prothorace

supra sparsius subtilissime, punctulatis; hoc quam longior plus (quam trans apicem paullo minus) quam duplo latiori; supra vix manifeste canaliculato, marginibus lateralibus sat latis manifeste concavis bene definitis antice modice angustatis, margine antico late minus fortiter emarginato, angulis anticis obtusis posticis acutis; elytris seriatim subfortiter punctulatis, interstitiis alternis æquabiliter sat crebre granulis nitidis insignibus, margine laterali sat angusto (quam *P. granulati*, Germ., multo angustiori); corpore subtus sat nitido; abdomine latera versus strigato. Long., 7-8 l.; lat., $3\frac{1}{2}$-4 l.

A somewhat nitid species notable for the extremely regular rows of conspicuous shining granules that adorn the alternate interstices of its elytra. The emargination of the front of its prothorax is decidedly wide and feeble as compared with that of some *Pterohelæi*. A specimen in my collection differs from the type in being of narrower form, with the elytra a trifle less nitid and the granules smaller. The difference is perhaps sexual.

New South Wales: Narrabri, etc.

P. bullatus, Pasc. The *habitat* of this species is curiously given as "South Australia (Queensland)." The description is much too scanty to be satisfactory (*e.g.*, no information as to the antennal structure, or the width of the explanate margins of the different parts). The large size and elytral granulation, however, distinguish it from most of the *Pterohelæi*, and as I have in my collection specimens from Queensland which agree very well with the description I have not much hesitation in identifying them with it. I have also a *Pterohelæus* from South Australia, which is extremely close to it and possibly furnishes the explanation of Pascoe's statement of *habitat*, though I doubt its being really identical specifically, on account of its being of still narrower form and with somewhat different elytral granulation; but without seeing more specimens it would not be well to give it a separate name. Champion attributes *P. bullatus* to Western Australia (Tr.E.S., Lond., 1894, p. 383), but I feel some doubt as to this reference being correct.

P. gracilicornis, sp. nov. Latus; minus parallelus; subnitidus; minus convexus; nigro-piceus, marginibus antennis palpis pedibus elytrorumque granulis plus minusve rufescentibus: antennis sat gracilibus, (articulis 6° 7° que quam latiores longioribus extus hoc vix illo haud dilatatis, 8°-10° transversis extus leviter dilatatis); capite prothoraceque crebre subtilius (nullo modo obscure) punctulatis; hoc quam longior (et postice quam antice) plus quam duplo latiori, supra nullo modo canaliculato,

marginibus lateralibus minus latis bene definitis fortiter concavis, margine antico profunde sat anguste emarginato, angulis anticis obtusis posticis leviter acutis; elytris leviter striatis, striis subtiliter profunde punctulatis, interstitiis alternis apicem versus granulis minutis nonnullis (his nonnihil rufescentibus) ornatis, margine laterali lato (quam *P. granulati*, Germ. nonnihil latiori); corpore subtus nitido; abdomine fere toto strigato. Long., 5 l.; lat., 3 l.

A species of broader and less parallel form than is usual in this group, resembling in outline the species that I take to be *P. peltatus*, Er. The granules on the elytra are confined to the subapical portion and are extremely small and inconspicuous.

Western Australia: Coolgardie and other localities.

P. ventralis, sp. nov. Sat parallelus; sat opacus; minus convexus; nigro-piceus, marginibus antennis palpis pedibusque rufescentibus: antennis modicis (articulis 6° quam latior longiori extus parum dilatato, 7° vix transverso extus sat dilatato, 8°-10° fortiter transversis extus fortiter dilatatis); capite crebre subtiliter, prothorace supra subtilissime minus crebre, punctulatis: hoc quam longior (et postice quam antice) plus quam duplo latiori, supra haud vel vix manifeste canaliculato, marginibus lateralibus fere ut *P. granulati*, Germ. (i.e., latis, sat planis, intus male definitis), margine antico sat anguste sat profunde emarginato, angulis anticis subrotundatis posticis sat acutis; elytris seriatim nonnihil geminatim minus fortiter punctulatis, interstitiis alternis granulis parvis nitidis sat æquabiliter ornatis, margine laterali angusto (quam *P. granulati*, Germ., multo angustiori); corpore subtus sat nitido; abdomine latera versus vix manifeste strigato. Long., 8 l.; lat., $3\frac{4}{5}$ l.

Allied to *P. granulatus*, Germ., but very distinct from it by the lateral margins of its elytra much less widely explanate: differs from *granulatus* also by, *inter alia*, its larger size, more elongate build, front of prothorax more narrowly emarginate, and with more rounded angles, elytra with more numerous granules, ventral segments almost without longitudinal wrinkles, etc.

Western Australia: Coolgardie, etc.

P. brevicornis, sp. nov. Elongatus; sat parallelus; sat opacus; minus convexus; piceus, antennis palpis marginibus pedibus et corpore subtus plus minusve rufescentibus: antennis brevibus (articulis 6° quam latior haud longiori extus fortiter dilatato, 7°-10° fortiter transversis extus

fortiter dilatatis); capite prothoraceque supra subtiliter sat crebre punctulatis; hoc quam longior duplo (postice quam antice dimidia parte) latiori, supra vix perspicue canaliculato, marginibus lateralibus latis (fere ut *P. granulati*, Germ.) extus manifeste reflexis intus manifeste definitis, margine antico sat profunde emarginato, angulis anticis obtusis posticis acutis; elytris seriatim subtiliter punctulatis, interstitiis planis (alternis granulatis), granulis parvis (his scutellum versus minutissimis), margine laterali sat angusto (quam *P. granulati*, Germ., multo angustiori); corpore subtus sat nitido. Long., $6\frac{1}{2}$ l.; lat., 3 l.

This species is readily distinguishable, in the aggregate having the 6th joint of the antennæ strongly dilated, by its very short antennæ, depressed form, flat elytral interstices, and very fine elytral granules,—the latter almost obsolete in the scutellar region. Its prothorax resembles that of *P. bullatus*, Pasc.

Central Australia. From the collection of the late J. Anderson.

P. puer, sp. nov. Sat parallelus; minus opacus; sat convexus; ferrugineus vel piceo-ferrugineus, marginibus antennis palpis pedibus et corpore subtus dilutioribus; antennis sat brevibus (articulis 6° quam latior haud longiori extus sat fortiter dilatato, 7°-10° fortiter transversis extus fortiter dilatatis); capite subtiliter, prothorace supra subtilissime, sat crebre punctulatis; hoc quam longiori vix plus quam duplo (postice quam antice dimidia parte) latiori, supra vix vel haud manifeste canaliculato, marginibus lateralibus latis (fere ut *P. granulati*, Germ.) extus perspicue reflexis intus bene definitis, margine antico sat profunde emarginato, angulis anticis obtusis posticis acutis; elytris seriatim sat subtiliter punctulatis, interstitiis alternis leviter convexis sat æquabiliter sat crebre granulis nitidis insignibus, margine laterali sat angusto (quam *P. granulati*, Germ. multo angustiori); corpore subtus sat nitido; abdomine latera versus crebre strigato. Long., $6\frac{1}{2}$-7 l.; lat., 3-$3\frac{1}{5}$ l.

Allied to *P. bullatus*, Pasc., from which it differs by *inter alia* its smaller size, its prothorax less transverse more narrowed and more deeply emarginate in front and with much better defined front angles, the alternate interstices of its elytra more distinctly convex, and the 6th joint of its antennæ scarcely transverse. In some examples the elytra have a slightly bronzy tone.

Western Australia. Apparently widely distributed.

LONGICORNES.

Macrones.

M. Besti, sp. nov. Elongatus; rostro testaceo; palpis obscure brunneis; antennis nigris apicem versus nonnihil picescentibus; capite postice nigro, pone oculos fortiter transversim rugato; prothorace nigro obscure rufescenti, quam latiori sublongiori, subtiliter aspero, tripartito, (hoc superne viso parte antica sat æquali ad latera dilatata; parte media fortiter elevata, in medio late profunde longitudinaliter sulcata, disco utrinque obsolete bituberculato, angulis posticis subdentiformibus, lateribus valde rotundato-dilatatis; parte postica minus brevi,—fere ut *M. rufi*, Saund.); scutello nigro; elytris pallide testaceis, sutura margine laterali lineisque discoidalibus 2 costiformibus, parte subsuturali lævi parte externa crebre sat fortiter punctulata; pedibus rufis, femoribus posticis in medio tibiis (basi summa et parte apicali exceptis) tarsisque anterioribus 4 infuscatis: sternis obscure rufis, abdomine (segmento basali albido excepto) rufo; femoribus nonnihil subclavatis, fere ut *M. rufi*, Saund. Long., 12 l.; lat., $1\frac{3}{5}$ l.

Easily distinguishable from the other described species of the genus by its colouring. Apart from colouring and size the known species of *Macrones* resemble each other rather closely. The following characters in combination, however, separate the present species satisfactorily from the rest (except *subclavatus*, Pasc. which I do not know, but which is very differently coloured): eyes large (as in *rufus*), and round; head very strongly wrinkled transversely in hind part; intermediate area of pronotum widely and equally sulcate in its whole length and having its sides roundly dilated; basal area of pronotum as long as in *rufus;* femora comparatively robust and subclavate (as in *rufus*). In respect of colouring, the head and prothorax black or dark piceous with the muzzle testaceous (almost whitish) separate this *Macrones* from all the others yet described.

Victoria: Buffalo Mount; taken by Messrs. Best and French, jun.

PHYTOPHAGA.

Paropsis.

P. acclivis, sp. nov. Mas. Sat late subovata, minus convexa, altitudine majori (a latere visa) sat longe pone marginem medium posita; modice nitida; ferruginea, elytris verrucis nigris ornatis, corpore subtus nigro rufo-variegato, antennis basi excepta obscuris; capite inæquali minus subtiliter sat rugulose punctulato, basin summam versus

nigricanti; prothorace quam longiori ut $2\frac{4}{5}$ ad 1 latiori, ab apice sat longe ultra medium dilatato, crebre sat fortiter (ad latera grosse rugulose) punctulato, lateribus fortiter arcuatis, late leviter deplanatis, angulis posticis nullis; scutello sublævi; elytris sub callum humeralem depressis, pone basin transversim leviter impressis, crebre fortiter sat seriatim (ad latera paullo magis, postice paullo minus, grosse) punctulatis, verrucis (his a basi ad apicem continuis) nonnullis elongatis nonnullis rotundatis instructis, interstitiis sat rugulosis, parte marginali a disco (per sulculum minus perspicua) indeterminate divisa, calli humeralis margine interno a sutura quam ab elytrorum margine sat multo magis distanti; segmento ventrali basali (hoc rufo) sparsim subtiliter punctulato; antennarum articulo 3° quam 4us paullo longiori. Long., $5\frac{1}{2}$ l.; lat., $3\frac{1}{2}$ l.

In Proc. Linn. Soc., N.S.W., 1901 (p. 160), I furnished a classification of the groups into which it appeared to me that the genus *Paropsis* could conveniently be divided. The present species appertains to Group iii. as there characterized. In *loc. cit.* 1896 (p. 643) I divided that group into sub-groups of which sub-group ii. must receive this species. In *loc. cit.* (pp. 653-657) I tabulated the then known species of this sub-group and in that tabulation the present species must be placed beside *P. comma*, Blackb., from which it may be thus distinguished: —

KK. Form much less wide; elytra less rounded at sides.	
L. Greatest height of the insect (viewed from the side) not behind middle of elytral margin	comma, *Blackb.*
LL. Greatest height of the insect (viewed from side) considerably behind middle of elytral margin	acclivis, *Blackb.*

I have no doubt that this distinction is shared by the female (which I have not seen). The greatest height of the insect is placed further from the base than in any other nearly allied species. It also differs from *P. comma* in numerous other respects, *e.g.*, larger size, narrower build, humeral callus much nearer lateral margin of elytra, absence of markings on the pronotum, sides of pronotum less distinctly (though not less widely) explanate, evidently closer punctura-

tion of elytra. Compared with *P. serpiginosa*, Er., it is much larger, with its pronotum much more widely explanate, etc.,—besides differing by the character tabulated above. From *P. baldiensis*, Blackb., it differs *inter alia multa* by the extreme feebleness of the post-basal impression on its elytra, and from *P. Sloanei* (also somewhat like it superficially) by *inter alia* the presence of a well-marked depression below the humeral callus. It should be added that the elytra of this insect are more or less clouded with a darker colour than that of the general surface, giving them in some examples a blotchy appearance, which obscures the verrucæ.

King Island (Mr. Lea).

Arsipoda.

Specimens of an *Arsipoda* taken by Mr. Lea on King Island appear on a first inspection to differ from *A. variegata* more definitely than is consistent with their representing a mere variety. Nevertheless, comparison with specimens which I have taken in Victoria and New South Wales and have been unable to distinguish from *variegata* by any satisfactory character, leads me to the conclusion that it would not be justifiable to treat these insular examples as a good species. I have from the Blue Mountains specimens which are distinctly intermediate in shape, colouring, and sculpture between those from King Island and ordinary Tasmanian specimens. It is of course possible that there are at least three or four very closely allied species very limited in habitat, of which *variegata* is one, but I cannot satisfy myself that that is the case. The present form may be characterized as follows:—

A. kingensis, Blackb. (? *variegata*, Waterh., *var.*). Quam forma normalis magis angusta, magis ovata; colore magis pallida (antennis fere totis testaceis); pronoto magis fortiter punctulato.

Appended Note.

Since writing my remarks on *Anodontonyx nigrolineata*, Boisd. I have examined a specimen in the Macleay Museum bearing a ticket in the handwriting of Mr. W. S. Macleay "*Sericesthis nigrolineata*, Macl." As W. S. Macleay was a contemporary of Boisduval and is quoted in Dejean's Cat. as authority for the name *nigrolineata* I have little doubt that Boisduval's name was taken from a specimen considered identical with that I am referring to. The specimen in the Macleay Museum bearing Macleay's label is specifically identical with that which was sent to me from Berlin as the type of *Scitala languida*, Er. This evidence seems to be

finally conclusive in confirming the identity of *Anod. (Seric.) nigrolineata*, Boisd. and *Anod (Scit.) languida*, Er. The Macleay Museum also possesses a specimen ticketed in W. S. Macleay's writing "*Sericesthis sublineata*, Macl." Although I cannot find any description to have been published under that name it may be well to note here that the specimen in question is merely a slight colour-var. of *A. nigrolineata* differing from the type by the feebleness of the black lines on its elytra.

The Quality of the Secondary Ionisation due to β Rays.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and J. P. V. Madsen, B.Sc., B.E., Lecturer on Electrical Engineering.

[Read October 1, 1907.]

The so called secondary radiation due to β rays has been studied by many observers. Quite recently McClelland and H. W. Schmidt have contributed important sets of papers upon the subject.

It is usual to estimate the amount or the energy of the primary and secondary streams by measuring the ionisation produced within an ordinary ionisation-chamber placed in the path of the rays, the principal reason being that such measurements can be made with convenience and accuracy.

But it is only under very special conditions that this procedure is legitimate, because the β particle produces more ions in traversing a given space when its velocity is small than when it is great; in other words, the ionisation increases as the speed diminishes. If two streams of β radiation are to be compared by this method, it is one of the essential conditions of success that the velocities of the two streams shall be the same, or similarly distributed. This would not be necessary if the ionisation-chamber were made so large that even the fastest β particles spent their ionising powers within it, and if the whole ionisation produced by a β particle might be taken as a measure of its energy. But it is usual to employ a small chamber, placed comparatively near to the source of the rays; and in this way an unfair advantage is given to the particles of smaller velocity.

The experiments to be described in this paper show that the secondary radiations returned by different substances struck by the same primary stream are not uniform in quality, but vary from substance to substance. When the atomic weight of the substance is small, the radiation is relatively soft; it contains a larger proportion of less penetrating rays. If, therefore, the constants of secondary ionisation are measured in the usual way, they are exaggerated in the case of substances of low atomic weight, as compared with those the atoms of which are heavier.

For the purpose of observing the secondary ionisation due to β rays we have adopted the form of apparatus shown

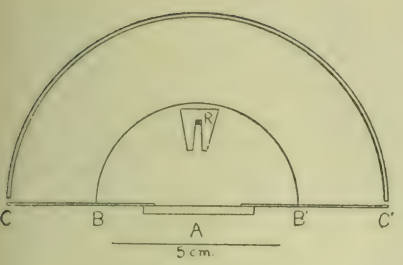


FIG. I.

in the figure. The plate at A scatters in all directions the radiation which it receives from the radium at R. Nearly all the returned particles strike the hemispherical wall BB′ of the ionisation chamber, the larger hemisphere CC′ being connected to the electrometer. The usual shielding devices are used, but not shown in the figure. This arrangement gathers in the effects of all the secondary rays, so that a measurable effect is obtained, even when only a small quantity of radium is used.

When the cup or dome BB is made of very thin Al foil, stretched on a frame of a few fine wires, the effects obtained by placing plates of different metals at A approximate to those given by McClelland—that is to say, the curve which shows the relation between secondary ionisation and atomic weight, is of the same general form as McClelland's, though somewhat flatter. But when the dome is thickened by the addition of layers of tinfoil, there is a considerable alteration. The addition of tinfoil of a tenth of a millimetre in thickness is sufficient to make the curve almost linear, and the ionisation is then nearly proportional to the atomic weight of the radiator.

The figures in the following table show the results of an experiment of this kind. They give the ionisation currents, on an arbitrary scale, for different radiators and different thicknesses of the dome. The smaller figures are only approximate: —

	Pb.	Ag.	Zn.	Fe.	S.	Al.	C.
1. Thin Al leaf	1300	1010	798	679	484	391	166
2. Sn. foil ·0065 mm	1124	829	627	519	352	276	141
3. ,, ·043	414	272	189	145	85	57	21
4. ,, ·080	210	129	87	65	35	21	8
5. ,, ·116	125	71	45	32	19	12	5
6. ,, ·153	76	42	29	21	13	7	5

Assuming that the returned radiation is really due to a scattering of the primary beam, there are two ways of interpreting these results. The β radiation of radium is heterogeneous, and consists of rays of various velocities. According to H. W. Schmidt there are a certain number of groups, each homogeneous in itself (Ann. der Phys., Nov., 1906). It

is conceivable that the effect of varying the atomic weight of the radiator might depend on the velocity of the β particle, and that the smaller atomic weights might return a relatively small amount of fast primary rays. Assuming the velocity of the secondary rays to be of the order of that of the primary, it would then follow that the constitution of a heterogeneous primary beam would be altered by scattering, the alteration depending on the atomic weight of the scattering substance or radiator, and being of the nature indicated by experiment. Crowther (Phil. Mag., Oct., 1906) has described an experiment which appears to show a considerable effect of this kind. He found that the secondary ionisation due to the β rays of UrX was much more nearly proportional to atomic weight than in the case of radium, as studied by McClelland, and he has suggested that the difference "may be due to the presence in the radium radiation of comparatively slowly-moving β rays." On the other hand, H. W. Schmidt has recently found (Ann. der Phys. Bd., 23, 1907) that the behaviour of substances under radiation from the β rays of UrX is not very different to that found by McClelland in the case of radium. As it was important to settle this point, if we were to find the true interpretation of our own experiments, we put together the apparatus of the form used by Crowther, and repeated his experiments with UrX, using also radium and actinium. The apparatus is not very well suited, as Schmidt points out, for obtaining accurately the proportion between secondary and primary; but it gives a ready answer to the question as to whether or no the speed of the β particle has any effect.

Subtracting the effects of the carbon plate from all the others, and setting lead equal to 200, we obtained the following results:—

	Pb.	Sn.	Ag.	Zn.	Cu.	Fe.	Al.	C.
Ac.	200	158	147	110	102	91	37	0
UrX... ...	200	160	147	110	102	87·5	36	0
Ra. 1. ...	200	155	145	106·5	99·5	86·5	34·5	0
Ra. 2. ...	200	152·5	141	101·5	94·5	79	31	0
Ra. 3. ...	200	152	145	99	82	68	25·5	0
Ra. 4. ...	200	132·5	123	88	82·5	73	27·5	0

The screens used were as follows:—

Ac—Thin mica + thin tinfoil; the two equivalent to about 10 cm. of air, and enough to cut off all α rays.

UrX—No screen.

Ra 1—Thin mica + tinfoil, the latter ·00366 cm. thick.

Ra 2—Thin mica + tinfoil, the latter ·0293 cm. thick.

Ra 3—Thin mica + tinfoil, the latter ·0586 cm. thick.

Ra 4—Thin mica + lead, the latter equivalent to ·11 cm. of tinfoil.

The figures for Ra 1, Ra 2, Ra 3, are for β rays only, the effects of γ rays having been eliminated. The figures for Ra 4 have not been corrected for γ rays, and must, indeed, refer almost entirely to rays of the latter class.

The velocity of the β rays of Ac is less than in the case of UrX. In the case of radium it varies; some of the rays are as little penetrating as those of Ac, others more than the rays of UrX. The figures seem to show that there is a certain small dependence on the velocity of the β rays, but it is insufficient to account for the variations in quality which have been described above.

We must therefore fall back upon a second explanation, viz., that the scattered rays possess velocities which are less, on the average, than those of the primary; and that the difference is greater in the case of the atoms of small atomic weight. This is in general accordance with other experiments and with expectation. It has been shown by Gehrcke (Ann. der Phys., viii., p. 81, 1902) that scattered cathode rays possess a variety of velocities, none greater than that of the primary, some, however, being equal to it. And it is not unreasonable to suppose that β rays lose more energy in being scattered by atoms of less weight or of looser building than by those which are heavier or more rigid. If, therefore, a homogeneous beam of β rays fell upon an aluminium plate, there would be found in the scattered secondary rays a larger proportion of particles of much reduced speed than if the plate had been lead.

When we measure the ionisation produced in an ionisation chamber, and insert successive thicknesses of absorbing material between the radiating substance and the chamber, placing them in contact with the wall of the latter, the effect is the same as if we gradually removed the chamber to greater distances; if we may assume that the law of absorption in air and in the given absorbing material is not greatly affected by the alterations in quality which we are considering. We may, therefore, take the figures in any vertical column of the first table given above as showing the effects of the secondary radiation at various distances from the radiator. If we plot an ionisation-distance curve the whole area between the curve and the axes is the true measure of the ionisation due to the returned rays. The usual plan is to accept as a measure the one figure at the head of the column.

We find that in each case the curve may be nearly expressed as the sum of two exponentials as $Ae^{-\lambda_1 x} + Be^{-\lambda_2 x}$. Whether this has a physical meaning or not does not concern our immediate argument. Commencing with one thickness of tinfoil on the dome, the actual figures are—

I.	II.	III.	IV.
Pb ...	$564e^{-60x} + 560e^{-13{\cdot}6x}$	200	200
Ag ...	$492e^{-57x} + 337e^{-14x}$	125	140
Zn ...	$409e^{-57x} + 218e^{-14x}$	83	98·5
Fe ...	$365e^{-54x} + 154e^{-14x}$	61·5	76·5
S ...	$264e^{-59x} + 78e^{-13{\cdot}5x}$	35	43
Al ...	$218e^{-73x} + 58e^{-14x}$	19·5	27·5
C ...	$117e^{-73x} + 23e^{-14x}$	0	0

The area of the curve is given by $A/\lambda_1 + B/\lambda_2$, and the relative values of the areas are placed in the third column, that of C being first subtracted and that of Pb being set equal to 200. In the last column are the corresponding figures when the amount of radiation is measured by A + B, *i.e.*, the ionisation found when one layer of tinfoil is placed over the chamber. It is clear that there is a considerable difference.

When tinfoil is placed over the radium itself so as to cut out a large proportion of the slower β rays, the secondary radiation is also hardened correspondingly.

The figures here given are not sufficiently accurate to be taken as absolute. The measurements were made as carefully as possible, but more numerous and more varied experiments are needed before it will be possible to map out the phenomena with exactness. But the results show clearly that—

(1) The secondary radiation from different substances, due to the β and γ rays of radium, varies in quality, those of lower atomic weight returning a greater proportion of less penetrating rays.

(2) When the less penetrating portion of a primary beam of β rays from radium is sorted out, the secondary rays also become more penetrating.

(3) In view of these considerations the ionisation current due to secondary radiation, measured in a chamber of the ordinary form, does not give a simple or accurate determination of the nature of that radiation.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part VII.

By Jos. C Verco, M.D., Lond., F.R.C.S., Eng., Etc.

Plate XXIX.

[Read September 3, 1907.]

Cyclostrema homalon, n. sp. Pl. xxix., figs. 3, 4.

Shell small, thin, flatly depressed, of 4½ whorls. Apical whorls convex smooth. Spire whorls flat excavately sloping towards the upper suture, rounded towards the lower, with a spiral near the upper suture, which is well adpressed so as to simulate another spiral, and two near the lower suture. Body whorl large, with about seven spirals, the lowest forming a basal carina, starting where the inner lip joins the body whorl at its base, and ending at the outer third of the basal lip. Umbilicus large and perspective, with about ten spiral liræ. There is a smooth area between the outermost and the basal carina. The aperture is quadrate, with rounded angles, and lies in an oblique vertical plane. The labrum is excavated at a little distance from the suture, then projects curvedly forwards, and then continuously retrocedes. The inner lip is applied to the base, so that the aperture is not quite circular or complete. Very fine crowded axial microscopic markings, which do not follow the sinuosities of the outer lip.

Dim.—Largest diameter, 2·7 mm.; smallest, 2 mm.; height, 1 mm.

Diagnosis.—C. harriettæ, Petterd, is closely allied, but has a less open umbilicus, and its labrum is not sinuous on the dorsum, but has a continuous convex curve; and the intra-umbilical spirals are much finer and more crowded.

Variations.—One variety attains a size of 4·1 mm. in diameter, and is more solid. Its aperture is rounder; the umbilicus wider and more perspective, is radially wrinkled, and may not have so many spiral liræ. There may be no spiral lira near the suture on the whorls, nor any elsewhere, or there may be several on the sides of the body-whorl. Some show the basal carina distinctly, others feebly, and others not at all; but the sinuosity of the lip is present and the miscroscopic radial markings.

Locality.—Type, 62 fathoms north-west of Cape Borda; var., 130 fathoms, Cape Jaffa.

Cyclostrema pachyston, n. sp. Pl. xxix., fig. 10.

Shell orbicular, depressed, of five whorls, spire slightly elevated. First two and a half whorls convex, smooth, followed by a spire-whorl, with five equidistant spiral liræ. Body-whorl upper surface flatly sloping, nearly smooth, with fine curved axial wrinkles antecurrent just below the suture, then obliquely retrocedent. Side convex, with four well-marked spiral liræ to the periphery. Base rounded with about eight spiral cords, very flat and low, separated only by incisions. Umbilicus minute, nearly filled up by flat callus expansions of the inner lip, producing rude curved radial wrinkles. Aperture round; outer lip oblique, thin and simple, somewhat crenulated outside by the liræ; basal part thicker and smooth; inner lip thin where applied to the base of the body-whorl, and expanding beyond the concave columella as a thick shiny smooth callus to the centre of the perforation.

Dim.—Greatest diameter, 2·15 mm.; smallest, 2 mm.; height, 1·5 mm.

Locality.—62 fathoms, north-west of Cape Borda, 10 dead.

The largest example is 3·2 mm. in diameter. In the larger shells the perforation becomes more open, and its sides are radially wrinkled.

Cyclostrema denselaminatum, n. sp. Pl. xxix., fig. 9.

Shell opaque-white, minute, turbinate, of four whorls, nearly detached, rapidly increasing. Protoconch one and three-quarter whorls, flatly convex, smooth. Spire-whorls convex. Sutures deep. Aperture circular, complete, detached from the base of the body-whorl; border simple. Umbilicus moderate, perspective. Sculpture begins abruptly from the protoconch; valid axial laminæ, about as high as wide, and one-half or one-third as wide as the interspaces, crowded, nearly 50 in the body-whorl, completely encircling the whorls and so visible in the umbilicus. Fine hair-like spiral threads, about 40 in the body-whorl, less crowded on the base and near the suture than on the periphery.

Dim.—Greatest diameter, 1·55 mm.; smallest, 1·4 mm.; height, 1·1 mm.

Diagnosis.—*Scala nepeanensis*, Gatliff, is more elate and has fewer axial laminæ. *Cyclostrema angeli*, Ten. Woods, is more elate and has a smaller perforation. *C. johnstoni*, Beddome, is similar in shape and has crowded axials, but has no spirals.

Locality.—Type from 62 fathoms, north-west of Cape Borda; Backstairs Passage, 22 fathoms, 6 dead.

Gibbula reedi, n. sp. Pl. xxix., fig. 5.

Shell solid, depressed conoid. Whorls, 4 smooth, flatly convex, slightly hollowed just below the suture. Summit blunt. Suture impressed. Periphery round, barely angulate. Base convex. Umbilicus moderate. Aperture oblique, roundly elliptical; outer lip simple, bevelled inside; a short thin glaze on the base of the whorl; columella arcuate, everted posteriorly, with a tiny notch where it joins the round basal lip at the end of the bordering lira of the umbilicus; throat smooth and iridescent. Sculpture: the dorsum looks as though it were spirally lirate, but is really quite smooth except for very fine miscroscopic curved retrocurrent accremental scratchings. On the base are about a dozen fine spiral incisions, with radial scratch-marks more valid and distant than on the dorsum; these are still stouter and wrinkling within and near the perforation. An inconspicuous lira borders the umbilicus, which has a shallow groove just above it. Colour, chestnut-brown, with dark-brown spiral hair-lines of varying width; dotted with tiny white spots, which, below the suture, are aggregated into small pyramidal blotches with their apex upward, six in the body-whorl. A white band, scalloped on both edges of these aggregated dots, encircles the periphery. An articulated white-and-brown spiral ornaments the lira bordering the umbilicus, a second lies just outside this, and another with more distant double white spots beyond; the rest of the base, which is of a lighter tint than the dorsum, has scattered tiny white dots. The umbilicus is white. Over all is a transparent glaze, with a bronze reflex.

Dim.—Greatest diameter, 6·2 mm.; smallest, 5 mm.; height, 3 mm. The species may reach 7·2 mm.

Locality.—The beach, Holdfast Bay (Tate); Leven's Beach, Yorke Peninsula (Zietz). It seems to be quite littoral. I have not dredged it.

There may be a faint gutter where the labrum joins the body-whorl. The colour may be dark-brown. The peripheral white band may fade out toward the aperture. The white blotches beneath the suture and the articulated bands around the perforation seem the most constant ornament.

It was formerly called in South Australia *Gibbula Fesserula*, Ten. Woods, and was so catalogued as No. 348 in Adcock's Handlist of the Aquatic Moll. of South Australia, 1893, but his species has been recognized as an immature *Diloma Adelaidæ*, Philippi.

It has been named after Mr. Walter Reed, a South Australian collector, who took it on our shores.

Adeorbis kimberi, n. sp. Pl. xxix., figs. 1, 2.

Shell minute, translucent, oval. Whorls $2\frac{1}{4}$. Spire very low. Apex blunt; protoconch half a whorl, its apex buried, smooth, rounded, marked off from the spire-whorl by a scar. Suture impressed, slightly excavate. Periphery sharply carinate. Base very flatly rounded, and pressed flat at the carina. Umbilicus very wide and not defined. Aperture roundly oval, nearly on the basal plane; outer lip uniformly round, simple, thin, pinched into a minute gutter close to the suture; inner lip is a thin glaze over the body-whorl. Columella slightly arcuate, its edge posteriorly expanded and reflected over the umbilicus. Sculpture: crowded fine microscopic curved accremental lines; on the base more valid and fewer, and as radiating curved wrinkles, which faintly crinkle the carina.

Dim.—Greatest diameter, 3·7 mm.; smallest, 2·9 mm.; height, 1·2 mm.

Locality.—Aldinga (Kimber). Dredged in St. Vincent Gulf in about 20 fathoms (Verco).

Diagnosis.—It is allied to *A. angasi*, Adams, but has not the distant tubercles on the carina.

It is named after the collector who found it.

Torcula runcinata, Watson. Pl. xxix., fig. 14.

Turritella runcinata, Watson, Proc. Linn. Soc., Lond., 1881, vol. xv., p. 218; Chall. Zool., 1886, Gasteropoda, vol. xv., p. 475, pl. xxx., fig. 3.

An individual of 38 mm. in length was dredged alive.

The radula is exceedingly small compared with the size of the shell. It has a somewhat quadrate rachidian tooth, finely denticulated, along the edge of its upper border, bent forward at a sharp angle. The single lateral is transversely rhomboidal, about twice as large as the central, and is also finely denticulate along the free edge of its bent-forward upper margin. The two marginals, elbowed about their middle, have a flange projecting from their upper border, and finely dentate. Miss J. Donald, in a paper on "Some Recent Gasteropoda, referred to the Family Turritellidæ, and their Supposed Relationship to the Murchisoniidæ," read January, 1900, and published in Pro. Mal. Soc., London, 1901, p. 47, etc., mentions *T. runcinata*, Watson, among other species of *Turritella*, and from their deep labral sinus suggests their affinity with *Murchisonia*. The Pleurotomariidæ and Murchisoniidæ are regarded as belonging to the Rhipidoglossa. But the radula of *T. runcinata*, Watson, plainly places it among the Tænioglossa, and allies it with the ordinary forms of *Turritella*, rather than with *Murchisonia*. If therefore *Murchi-*

sonia is to be associated with those *Turritellas* which Miss Donald has grouped under a new section, *Colpospira*, because of their deep sinus, this group must still be placed among the Turritellidæ, and *Murchisonia* must be shifted with them into the same family, among the Tænioglossa, and separated from the Pleurotomariidæ and other Rhipidoglossa. But the resemblances in the test of her *Colpospira*, and of *Murchisonia* are scarcely sufficient to justify this.

Actæon roseus, Hedley, *var.* **areatus,** new var.

Actæon roseus, n. sp., Hedley, Proc. Linn. Soc., New South Wales, 1905, p. 535, pl. xxxiii., f. 42. Type locality—Wyargine Point, Middle Harbour, Sydney; also Eden, New South Wales.

Our South Australian shell has a shorter spire and a longer aperture; also two white spiral bands and several undulating axial bands, which break the colour up into oblong blotches. Dredged in 18 fathoms, Investigator Strait; 22 fathoms, Yankalilla Bay; 15 fathoms, off Point Marsden, Kangaroo Island; and 25 fathoms, Thorny Passage, Spencer Gulf; all dead.

Actæon retusus, n. sp. Pl. xxix., fig. 12.

Shell oval, shining, translucent, yellowish-white, thin, of six whorls. Protoconch of one whorl, apex immersed, convex, quite smooth, ending abruptly in an oblique retrocurrent scar. Spire whorls roundly shouldered immediately below the suture, then convexly sloping. Suture deeply narrowly channelled. Body-whorl roundly-obliquely cylindrical. Aperture obliquely-arcuately pyriform. Outer lip simple, smooth inside, finely-crinkled outside, very slightly compressed above its centre; basal lip well-rounded, its inner half distinctly everted. Columella with a wide, simple oblique fold just below the base of the body-whorl, over which the thin inner lip is applied to join the labrum at the suture. Umbilicus small.

Spiral incisions, six in the penultimate, forty in the body-whorl, extending to the columella, where they become crowded and fine. Very delicate, close-set, axial striæ cross the incisions, which they punctate, climb, and crenulate their sides, and traverse the intervening flat spiral bands.

Dim.—Length, 9·4 mm.; breadth, 6·1 mm. Length of aperture, 6·5 mm.; width, 2·9 mm.

Locality.—Type, 200 fathoms, off Beachport, with two other examples; also in 100, 110, and 150 fathoms; off Cape Jaffa in 90 and 130 fathoms; N.W. of Cape Borda in 60 fathoms. In good condition, but none alive.

Diagnosis.—It differs from *A. roseus*, Hedley, var. *areatus*, Verco, in having a much less acute apex, a more elevated spire, narrower incisions, more crowded axial striæ, a less pro-

nounced columellar fold, and the absence of the colour-pattern.

Variations.—One shell is somewhat more ventricose, another more elate, with more valid axial striæ; the former has two faint rusty blotches of colour on the dorsum of the body-whorl, a little below the suture; the latter has the trace of a pinkish tinge.

Pupa intermedia, Angas.

Buccinulus intermedius, Angas, Proc. Zool. Soc., London, 1878, p. 862, pl. liv., f. 11. Type locality, Aldinga.

Adcock, Handlist of Aquatic Moll. of S. Austr., 1893, p. 10, No. 424.

Solidula intermedia, Angas, Pilsbry., Man. Conch, vol. xv., 1893, p. 145, pl. xxA, figs. 55, 56.

It has been dredged dead in Hardwicke Bay, Spencer Gulf, Investigator Strait, St. Vincent Gulf, and Backstairs Passage, at all depths from 14 to 22 fathoms, and at 62 fathoms N.W. of Cape Borda. It has been taken alive at 15 fathoms, Investigator Strait.

It exhibits the following variations:—The middle third of the body-whorl may be slightly concavely compressed. The axial sculpture may vary from microscopic accremental striæ, just punctating the spiral incisions, when these are narrow, or crenulating their edges when wider, up to fairly well-marked oblique striæ, which divide the wide incisions into squarely-rounded shallow pits, and cross the intervening flat riblets. The spiral incisions may be equidistant all over the body-whorl, or absent from the upper half of the body-whorl, or they may be trebly distant here. They may be merely very fine and shallow punctate engravings, or rather wide furrows with crenulated edges, or latticed into squarish pits. But all variations grade into one another.

Pupa hyalina, n. sp. Pl. xxix., fig. 11.

Shell minute, diaphanous, fusiformly oval, five whorls. Protoconch distinct, glassy, smooth. Suture adpressed. Whorls sloping, convex. Aperture narrow, long, and pyriform. Outer lip uniformly curved, simple, thin, continued into a round basal lip, which is thickened towards the columella. The inner lip is a thin glaze over the body-whorl, and is expanded slightly beyond the pillar over the perforation. There is a curve of the columella forming a plait running into the basal lip, and a second well-marked oblique plait where the pillar joins the body-whorl. The spire-whorls have sublenticular wavy spiral incisions, which also cover the body-whorl, being most marked at the base, and nearly as well marked below the suture. Very fine, rather sinuous, accremental striæ. Colourless.

Dim.—Length, 3 mm.; diameter, 1·5 mm.; length of aperture, 2·2 mm.

Locality.—Fowler and Streaky Bays (Tate).

Myodora tasmanica, Tenison Woods.

Myodora Tasmanica, n. sp., Ten. Woods, Proc. Roy. Soc., Tasm., 1875 (1876), p. 160. Type locality—Long Bay, Tasmania. Tate and May, Proc. Linn. Soc. N.S.W., 1901, vol. xxvi., part 3, p. 422, pl. xxvii., figs. 104-106.

Dredged off Beachport in 100 fathoms, 5 valves; in 110 fathoms, 50; in 150 fathoms, 2; and in 200 fathoms, 2 valves. It was not taken in shallower waters off the same place, and has not been taken on the South Australian beaches. It appears not to have been recorded from Victoria nor from New South Wales.

Crassatellites kingicola, Lamarck.

This shell was referred to by me in these Transactions, vol. xxix., 1905, p. 169, as *C. ponderosus*, Gmelin. It appears now that our *C. castanea*, Reeve, should be regarded as a variety of *C. kingicola*, Lamarck.

It has been dredged in a subfossil state in soft limestone in the Port Adelaide Channel. One valve was taken in 40 fathoms, and two in 100 fathoms off Beachport, both small and poor. Hitherto, therefore, its habitat has been very restricted as to depth, viz., from 15 to 20 fathoms.

Crassatellites discus, Hedley.

Crassatellites discus, Hedley, Records Austr. Mus., vi., 1907, p. 300, pl. lvi., figs. 26-27. Type locality, 80 fathoms, off Narrabeen, New South Wales.

None were dredged alive, but valves in good condition were obtained. Off Beachport, at 40 fathoms, 31 valves; at 49 fathoms, 22 valves; at 100 fathoms, 4 valves; at 110 fathoms, 20 valves; at 150 fathoms, 17 valves; and at 200 fathoms, 2 valves. Off Cape Borda, at 55 fathoms, 7 valves; and at 62 fathoms, 5 valves. Off Cape Jaffa, in 130 fathoms, 14 valves. This seems not to occur in the gulfs of South Australia, but to be an ocean form, and to affect the deeper waters.

Crassatellites carnea, Tate.

Crassatella carnea, Tate, Trans. Roy. Soc., S. Austr., vol. xiv., p. 263, pl. xi., f. 1, 1a. Type locality—Yankalilla Bay.

It has been dredged alive at all depths from 9 to 23 fathoms, most abundantly from 20 to 23 fathoms. Valves have been taken, small and in poor condition, off Beachport at 110 and 200 fathoms, and off Cape Jaffa, in 90 fathoms. Comparatively large valves were taken off Beachport in 40

fathoms, the largest being 25 mm. antero-posteriorly, and 20 mm. umbo-ventrally. Tate, in his original diagnosis, remarked: "This species is very like *C. aurora* and *C. Banksii*, Adams and Angas, inhabiting Bass Straits, with regard to colour, ornament, and crenated margin of valves. It is, however, of a different form, is as widely removed from *C. aurora* as that species is from *C. Banksii;* thus, *C. Banksii* is oblong-ovate, *C. aurora* transversely ovate, and *C. carnea* is more rotund. They may eventually prove to be variations in shape of an aggregate species."

The proportion of length to height in *C. aurora* is 24 to 17, or as 100 to 71. That of Tate's type is 22 to 19, or 100 to 86·8. That of my largest is 25 to 20, or 100 to 80. Therefore my largest shell approximates somewhat more to the type of *C. aurora* than does Tate's type of *C. carnea*, but is still much shorter; and as my larger shell is larger than Angas's type, and is nevertheless shorter, and is an old stout shell, the difference is not explained by the senility of Angas's shell. *C. carnea* may consequently be retained for the present as a distinct species.

Crassatellites banksii, Adams and Angas, *var. angustior;* n. var.

Crassatella banksii, Adams and Angas, Proc. Zool. Soc., Lond., 1863, p. 427, pl. xxxvii., fig. 16. Type locality—Banks Straits. Conch. Cab. Kuster, 1886, bd. x., abt. i., p. 26, pl. vii., f. 14.

In 55 fathoms north-west of Cape Borda I dredged 16 small and 33 large valves of a species which corresponds with *C. Banksii* in its oblong-ovate shape and truncated posterior end and colouring. Its dimensions, however, do not correspond. It is narrower antero-posteriorly for the same height. *C. banksii* is 16 mm. long by 10 high; mine are 12 mm. long by 10·2 high—hence the name *angustior*. My largest specimen is 23 mm. by 20·5. To be in proportion it should be 32·8 mm. long instead of 23. I have preferred to call it a variety rather than create another species based on this one difference. It has not occurred elsewhere in my dredging.

Crassatellites producta, Verco.

Crassatella producta, n. sp., Trans. Roy. Soc., S. Austr., 1895, vol. xix., p. 92, pl. 1., f. 2.

Fifty valves were dredged off Cape Borda in 55 fathoms, in very good condition. Beyond this depth in the same neighbourhood at 60 and 62 fathoms; off the Neptunes, in 104 fathoms; and off Beachport, in 110 fathoms; from one to six valves in poor preservation were obtained, and none beyond. Its habitat is probably from 15 to 20 fathoms, up to 50.

Crassatellites micra, Verco.

Crasatella micra, Verco., Trans. Roy. Soc., S. Austr., 1895, vol. xix., p. 93, pl. 1, fig. 3.

Previously dredged alive in 20 and 22 fathoms; one has since been taken alive in 16 fathoms, three miles off Tunk Head, and one perfect individual and 11 valves in 62 fathoms north-west of Cape Borda. Valves have been obtained off Beachport, 10 in 49 fathoms, and 12 in 110.

Crassatellites probleema, n. sp. Pl. xxix., figs. 6, 7.

Shell transversely-orbicularly oval, solid, projecting anteriorly. Umbo prominent, incurved, prosogyre, acute. Post-dorsal side roundly sloping; anterior dorsal side concave near the umbo, then nearly straight, continuing into a well-rounded front side; ventral border with a uniform open curve, merging into the slope of the posterior side, with an inconspicuous round angulation. The surface is corrugated with about twenty solid wide concentric ribs, more projecting at their upper border, wider than their interspaces. For about 2·5 mm. from the apex the surface is smooth. Inner border simple and smooth. Colour light horn-tint.

Dim.—Antero-posterior diameter, 10·3 mm.; umbo-ventral, 9·4 mm.; sectional of the two valves, 4·25.

Locality.—Off Beachport, in 100 fathoms, 2 valves; 150 fathoms, 14 valves.

Diagnosis.—In shape it is very like *C. micra*, Verco; but this is a much smaller shell, with an equal number of concentric ribs, and these extend quite up to the apex. It closely approaches *C. discus*, Hedley, in the smooth area near the umbo, and in the marked concentric ribbing, but has the front much more produced, and the postero-lateral area not flat or truncated at the border.

Variations.—In some the angle at the umbo is more acute and in others less than in the type, so that the shell is proportionally narrower or wider. In some, especially the wider ones, there is a tendency to slight truncation in the posterior part of the ventral border.

Lima multicostata, Sowerby.

Lima multicostata, Sowerby, Thes. Conch., 1847, vol. 1, p. 85, sp. 6, pl. xxii., f. 38. Type locality—"Mediterranean (?)" Reeve's Conch. Icon., 1872, vol. xviii., pl. 1, f. 4; E. A. Smith, Chall. Rep., Zool., vol. xiii., 1885, p. 288; Tate, Trans. Proc. Roy. Soc., S. Austr., 1886, vol. ix., p. 108; Tate and May, Proc. Linn. Soc., N. S. Wales, 1901, vol. xxvi., part 3, p. 440; Pritchard and Gatliff, Roy. Soc., Vict., 1904, vol. xvii., (N.S.), part 1, p. 259.

Radula lima, Linné, Angas, Proc. Zool. Soc., Lond., 1865, p. 656, No. 91; Ten. Woods, Proc. Roy. Soc., Tasm., 1878, p. 56.

Lima lima, Linn, *var. multicostata*, Sowerby, Hedley, Mem. Austr. Mus., vol. iv., 1902, p. 309.

Dredged alive at all depths, from 9 to 30 fathoms; embedded in sponge or attached inside dead *Pinna inermis*, etc. Off Beachport and Cape Jaffa, valves only, at 49, 110, 130, and 200 fathoms. One specimen, at 110 fathoms, off Beachport, has 45 ribs; usually they have from 25 to 30.

Lima bullata, Born.

Ostrea bullata, Born., Mus. Caes. Vindobon, 1780, p. 110, pl. vi., f. 8; Dillwyn, Desc. Cat., 1817, p. 270.

Lima bullata, Born., Sowerby, Thes. Conch., 1843, vol. i., p. 84, pl. xx., f. 32, 33; Hanley, Cat. Rec. Bivalve. Shells, 1843, p. 266; Sowerby in Reeve's Conch. Icon., 1872, vol. xviii., p. 1, f. 3 *a* and *b*; Tate, Trans. Roy. Soc., S. Austr., 1886, vol. ix., p. 109, No. 162; Adcock, Handlist Aquatic Moll., S. Austr., 1893, p. 14, No. 202; Hedley, Mem. Austr. Mus., vol. iv., part 5, 1902, p. 310.

Radula (Limatula) bullata, Born., Angas, Proc. Zool. Soc., Lond., 1865, p. 656, No. 93.

Lima (Limatula) bullata, Born., Tryon, Struct. and Syst. Conch., 1884, vol. iii., p. 287, pl. 132, f. 93; E. A. Smith, Chall. Zool., 1885, vol. xiii., p. 292; Tate and May, Proc. Linn. Soc., N.S. Wales, 1901, vol. xxvi., part 3, p. 440; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xvii. (N.S.), part 1, p. 260.

Lima strangei, Sowerby, in Reeve's Conch. Icon., 1872, vol. xviii., pl. 1, f. 3*a*, *b*.

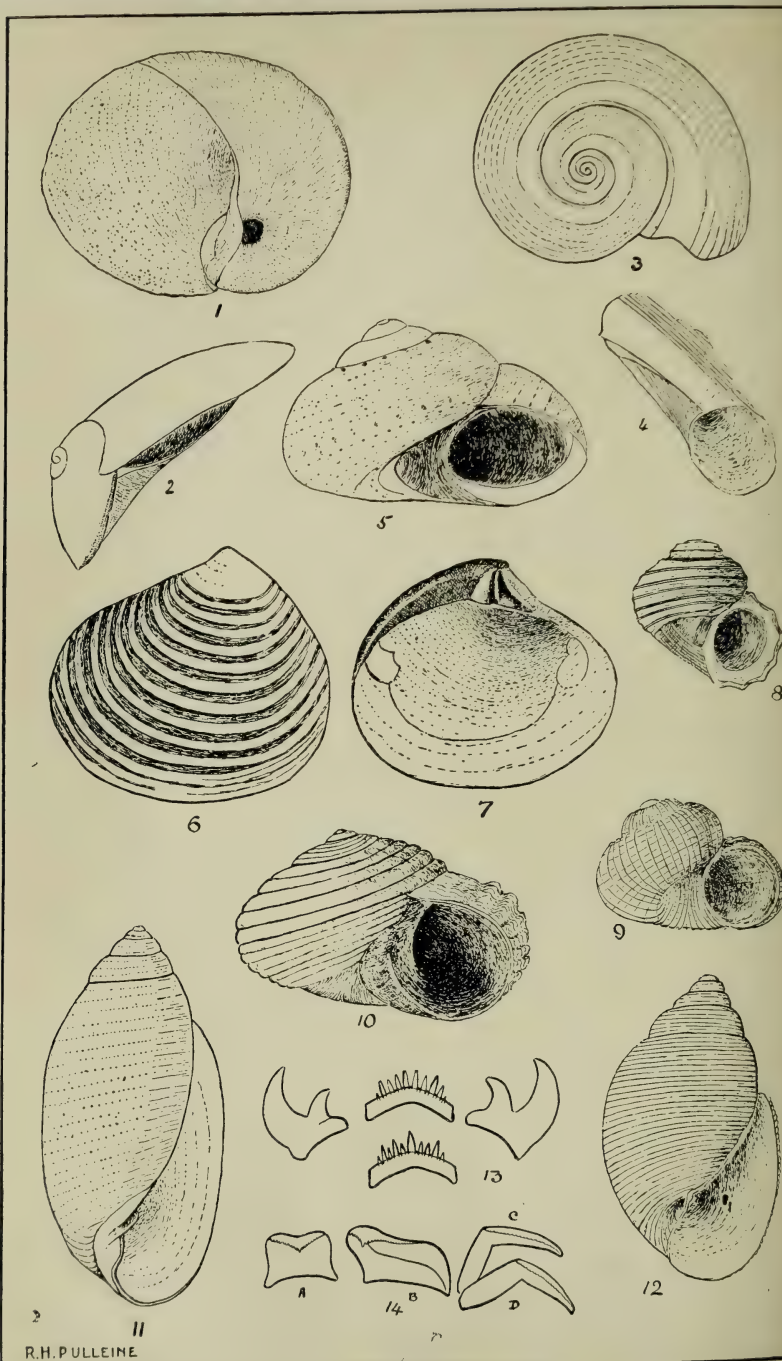
Dredged alive at Port Lincoln in 9 fathoms, 1 very small; in Backstairs Passage in 18 fathoms, 1, and in 20 fathoms, 4, so that it is very rare in deep water. Valves have been taken off Beachport, Cape Jaffa, and off the Neptune Islands at 40, 60, 90, 100, 150, and 200 fathoms, generally in poor condition, especially the larger examples.

Lima angulata, Sowerby.

Lima angulata, Sowerby, Thes. Conch., 1843, vol. i., p. 86, pl. xxii., f. 39 and 4. *Type locality.*—Panama and Bay of Caraccas, 10 to 12 fathoms. Sowerby, in Reeve's Conch. Icon., 1872, vol. xviii., pl. iii., f. 13; Tate, Trans. Roy. Soc., S. Austr., 1886, vol. ix., p. 109; Adcock's Handlist, 1893, p. 14, No. 201; Hedley, Mem. Austr. Mus., 1902, vol. iv., p. 310.

Radula (Mantellum) angulata, Sowerby, sp. Angas, Proc. Zool. Soc., Lond., 1865, p. 656, No. 92.

In Hardwicke Bay, Spencer Gulf, they occur in enormous numbers, from near shore to fifteen miles out, forming nests of small shells and fragments of shell in dead *Cardium* valves, etc., in about 15 fathoms. They have also been dredged at all depths from 9 to 24 fathoms, alive, throughout Spencer and St. Vincent Gulfs and Backstairs Passage. Off Beachport 4 well-preserved valves were taken in 110 fathoms, and 5 in 200 fathoms. It appears not to have been secured in Victoria or Tasmania, though taken off the coast of New South Wales in 50 and 75 fathoms, as valves.



Hussey & Gillingham, Printers, Adelaide.

Limæa murrayi, Smith.

Lima murrayi, Smith, Proc. Zool. Soc., Lond., 1891, p. 444, pl. xxxv., f. 26.

Limæa murrayi, Smith, Hedley, Records Austr. Mus., vol. vi., part 3, 1906, p. 223.

L. acclinis, Hedley, Records Austr. Mus., vol. vi., part 2, 1905, p. 46, f. 10. *Type locality.*—100 fathoms off Wollongong, also 300 fathoms east of Sydney Heads, N.S. Wales.

Dredged, separate valves, off Beachport, in 100, 110, 150, 200 fathoms; off Cape Jaffa in 130 and 300 fathoms; and in 104 fathoms, 35 miles south-west of Neptune Islands.

Limæa austrina, Tate.

Limæa austrina, Tate, Trans. Proc. Roy Soc., S. Austr., vol. ix., 1886, p. 73, pl. iv., f. 7.

This is a common shell in deeper water. It has been dredged alive, at all depths, from 15 to 22 fathoms in Investigator Strait, Backstairs Passage, and off Newland Head; 1 in 8 fathoms, Eastern Cove, Kangaroo Island; and 1 in 49 fathoms, Beachport. It seems to be most abundant about 20 fathoms. Valves have been obtained in Spencer and St. Vincent Gulfs; as far east as Beachport, where it has been taken at 40 and 49 fathoms in numbers, and good; at 100, 150, and 200 few and poor; and as far west as Cape Borda and the Neptunes, in 45 and 55 fathoms.

EXPLANATION OF PLATE XXIX.

1. *Adeorbis kimberi*, Verco, ventral view.
2. ,, ,, ,, side view.
3. *Cyclostrema homalon*, Verco, dorsal view.
4. ,, ,, ,, side view.
5. *Gibbula reedi*, Verco.
6. *Crassatellites probleema*, Verco, exterior.
7. ,, ,, ,, interior.
8. *Leptothyra carinata*, Verco.
9. *Cyclostrema denselaminatum*, Verco.
10. ,, *pachyston*, Verco.
11. *Pupa hyalina*, Verco.
12. *Acteon retusus*, Verco.
13. *Arculara dipsacoides*, Hedley, radula.
14. *Torcula runcinata*, Watson, radula: A., rachidian; B., lateral; C.D., marginals.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1906-7.

ORDINARY MEETING, NOVEMBER 6, 1906.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.), in the chair.

PAPERS.—"The Phosphate Minerals from Elder Rock," by DOUGLAS MAWSON, B.E., B.Sc., and W. T. COOKE, D.Sc. "Geological Features of Part of Eyre Peninsula," by DOUGLAS MAWSON, B.E., B.Sc. "The Wadella Springs and Associated Bog Iron-ore Deposits," by the same author. Mr. Howchin apologized for the absence of Mr. Mawson, and read the papers contributed by the latter.

ORDINARY MEETING, MAY 7, 1907.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.), in the chair.

NOMINATIONS.—R. F. Purdue, Mining Agent, Launceston, Tasmania; H. C. E. Muecke, Agent, Adelaide; John Darling, Corn Merchant, Adelaide; Professor R. W. Chapman, M.A., B.C.E., Adelaide University; W. T. Cooke, D.Sc., Adelaide University.

EXHIBITS.—J. G. O. TEPPER, F.L.S., a caterpillar fungus from Davenport, England. This fungus (*Sphæria militaris*) is of a bright-scarlet colour and erect growth. It would appear that, owing to the caterpillar burying itself in the soil preparatory for its pupa state, the spores of the fungus very readily find their way into the creature's body, which becomes filled with the mycelium of the plant. Mr. W. HOWCHIN, F.G.S., exhibited a piece of barbed wire from a fence at Blackfellows' Creek which had been struck by lightning. The lightning had run along the fence for 5 or 6 panels, fusing the surfaces of the wires and welding together some of the barbs. Leaving the fence the charge struck a tree about a chain away, splitting the butt and tearing up the ground around. The PRESIDENT exhibited a fulgurite or lightning-tube. The portion shown was 18 centimetres

(about 7 inches) long and 33 millimetres (about $1\frac{1}{3}$ inches) in diameter. The wall of the tube was about 1·5 to 2 millimetres in thickness, and was composed of fused sand, smoothed and glazed on the inner surface, rough like sandpaper outside, and longitudinally folded in about seven nodose corrugations. It was very brittle. This fulgurite was given to Dr. Verco by Mr. Whitton, of Warrina, near Oodnadatta, who supplied the following particulars:—At the end of November, 1902, a severe thunderstorm passed over the district, and a tremendous explosive report was heard, attended by a marked vibration of the ground. The next day a black boy found, about three-quarters of a mile from the station, a stunted mulga-tree, one of whose branches was split and charred, and immediately below was a depression in the sand. Groping in this he found a piece of sand tube, and took it to the station. Mr. Whitton visited the spot and followed the tube down for about 12 feet, beyond which he could not go, because the sand rolled in as fast as he threw it out. The tube stood in almost a vertical position, and varied but little in diameter and in the thickness of its walls. These curious tubes, produced by lightning, are not uncommon in New South Wales, and are found, Mr. Mawson stated, in the high peaks of Mexico and in the Pacific islands, and on Mount Ararat they have been found to penetrate the Andesite rocks. Mr. A. H. C. Zietz, F.L.S., Assistant-Director of the Museum, showed bones of kangaroos and the extinct "pouched lion" *(Thylacoleo carnifex)*, found by Mr. Zietz and his son at Salt Creek, Normanville. The kangaroo bones were very clearly marked by the sharp-cutting teeth of the marsupial "lion." Mr. Zietz also exhibited varieties of goldfish *(Carassius auratus)*. These fish vary much in size, colour, and general appearance. Specimens have been obtained from the Murray and Torrens Rivers over a pound each in weight. The dark variety is numerous in both rivers. Those received in the Museum lately were killed by the influx of saltwater into the Murray. About a dozen varieties have been described.

Papers.—"A New Species of Microtis" *(M. orbicularis*, nov. sp.), by R. S. Rogers, M.A., M.D. "Notes on South Australian Marine Mollusca, with Descriptions of New Species." Part v., by J. C. Verco, M.D., F.R.C.S. "Mineral Notes," by Douglas Mawson, B.E., B.Sc. "New Australian Lepidoptera," by Oswald B. Lower, F.E.S. "A Comparison of the Various Types of Electric Radiation," by Professor W. H. Bragg, M.A., F.R.S.

Professor E. H. Rennie, D.Sc., and The President referred to Professor Bragg's scientific investigation of radiant

matter, and congratulated him upon the distinction conferred by the Royal Society of London, in electing him as a Fellow.

Ordinary Meeting, June 4, 1907.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Nominations.—John McConnell Black, Pressman, and R. H. Pulleine, M.B., C.M., both of Adelaide, as Fellows.

Ballot.—Rudolph Fison Purdue, Mining Agent, Tasmania; Hugo Carl Emil Muecke, Agent, and John Darling, Corn Merchant, both of Adelaide; and Professor R. W. Chapman, M.A., B.C.E., and W. T. Cooke, D.Sc., both of Adelaide University, were unanimously elected as Fellows.

Exhibits.—J. G. O. Tepper, F.L.S., exhibited two cases of Australian micro-moths, which, with ten other cases in the Museum, were collected by the late W. Guest, and rearranged by Mr. Tepper; only about 2 per cent. of these are destructive or injurious in the garden and field. The *Cryptophaga impunctata* is very injurious to cultivated trees. Mr. Tepper also exhibited the contents of the crop of a black magpie, sent to him by Mr. J. W. Mellor, containing the remains of two species of insects, not generally eaten by birds; one of these a bug belonging to the same family as the bed-bug, and some berries, possibly from one of the *Styphelias*. Mr. Tepper also showed a cockroach (*Ataxigamia* sp.) from Kalgoorlie (very similar to the warehouse insect) from Mr. Ashby. Mr. W. B. Poole exhibited a number of photo-micrographs of diatoms and transverse sections of the stems of plants, highly magnified. Mr. E. Ashby, a very handsome cock lyre-bird, from the Maconolly Ranges, and the skins of a megapode and young, from Northern Australia. Judging from the appearance of the country where the lyre-bird was found, Mr. Ashby thinks that these birds would thrive in the hills around Adelaide and on Kangaroo Island. He also mentioned instances of mimicry by lyre-birds. Mr. Ashby gave some further notes on the mound-building megapodes of Northern Australia, from information given by Mr. C. E. May, of Port Keats, who examined four nests of these birds in that neighbourhood. These nests were all slightly flattened on the tops, and more or less covered with small brushwood, which, it appears, had been thrown up by the birds themselves. This brushwood prevents the earth, of which the mounds are composed, from setting too hard. The flattening of the top is possibly caused by the natives digging for the eggs and in so doing pulling the top down. The megapode always selects a thick jungle amongst tamarind-trees for its mound. Many of these

tamarinds are, perhaps, 100 years old, and in some cases they grow out of the nests or mounds. These nests, evidently of considerable age, are used year after year by many generations of egg-laying megapodes. Each season the bird scratches and tunnels to a depth of from 2 to 5 feet into the old nest, at an angle of about 45 degrees, and lays 5 or 6 eggs, each one being placed 2 or 3 feet from its neighbour. There are reasons for thinking that these tunnels are used year after year, but this has yet to be proved. In nest No. 2, the dimensions of which are given below, the tunnel had been filled in with green leaves; a trail 60 feet long led up to where the newly-laid eggs had been placed.

Measurements of four Mound Nests:—

	Diameter of Base.	Circumference.	Height of Mound.	Diameter of Top.
	ft.	ft.	ft. in.	ft.
No. 1 ...	53	167	8 0	17
No. 2 ...	46	147	7 7	12
No. 3 ...	33	105	5 9	12
No. 4 ...	42	132	7 6	12

From these measurements it appears that a close similarity exists in the size and shape of the nests. No 1, the largest mound, is probably the oldest.

Ordinary Meeting, July 2, 1907.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—John McConnell Black and R. H. Pulleine, M.B., C.M., were elected as Fellows.

New Premises.—The President congratulated the Society upon meeting in its new room, and expressed a hope that the Government would erect some shelving for the library.

Obituary.—The President referred to the death of Mr. John Dennant, F.G.S., one of the Honorary Fellows, who had been connected with the Society since 1888, and had contributed to its Transactions several geological papers, and a series of papers on corals, which his death leaves incomplete.

Exhibits.—Mr. Zietz, F.L.S., C.A.Z.S., exhibited birds' skins from various parts of Australia, including thick-heads, finches, honey-eaters, and wrens.

Mr. J. G. O. Tepper, F.L.S., (1) a stone-making fungus, *Laccocephalum*, McAlp. et Tepp.; (2) galls on apple-tree roots, showing mode of propagation of woolly aphis; (3) some rare specimens of *Buprestidæ* and *Cetonidæ;* (4) first specimen of fruit-fly *(Tephritis musæ)* found in South Aus-

tralia, which was picked up dead on a gravel path in Adelaide.

Dr. Morgan exhibited—(1) Pelvis, sternum, and shoulder-girdle of the lyrebird, and similar bones of the magpie and parrot for comparison; (2) syrinx or vocal organ of lyrebird; (3) contents of stomach of same, consisting of beetles, spiders, caterpillars, and small stones.

Dr. Pulleine, M.B., C.M., the male of the common trapdoor spider.

The President exhibited a pair of fins of a fish attributed by Mr. Zietz to the butterfly gurnard, not the flying gurnard; (2) a cuttlebone of an apparently new species resembling somewhat the *Sepia elongata* of the Red Sea; (3) a crab which had lost its left claw at the second articulation, showing a capsule springing from the joint, containing the embryo of the whole of the missing parts.

Papers.—The following papers were laid on the table:—"Notes on South Australian Decapod Crustacea," Part v., by W. H. Baker. "New Australian Lepidoptera, with Synonymic Notes," No. xx., by Oswald B. Lower. "Descriptions of Australian Curculionidæ, with Notes on Previously-described Species," Part v., by Arthur M. Lea, Government Entomologist, Tasmania.

Ordinary Meeting, August 6, 1907.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Nomination.—Robert Thomson Melrose, of Mount Pleasant, as a Fellow.

Dr. Pulleine, referring to the proposal to transfer the classified collection of plants in the Botanic Gardens to the experimental area, expressed his fear that in so doing many valuable Australian shrubs now growing in the classified borders might be destroyed. For this reason, and also that a properly-classified garden for the study of botany might be secured, Dr. Pulleine proposed—"That in the opinion of this Society the classified garden in the Botanic Gardens should not be abolished, but preserved in its present site, and as far as possible the natural orders and species should be represented by Australian plants"; seconded by Mr. Black, and carried.

It was further proposed by Mr. S. Dixon, seconded by Mr. Howchin, and carried—"That a copy of the above resolution be forwarded to the Chairman of the Board of Governors of the Botanic Gardens."

Dr. Pulleine was requested to interview Mr. Holtze, the Director of the Gardens, in reference to this matter.

PAPERS.—The following papers were laid on the table:—"Revision of the Australian *Psychidæ*," by EDWARD MEYRICK, B.A., F.L.S., and OSWALD B. LOWER, F.E.S., Lond. "Notes on South Australian Marine Mollusca, with Description of New Species," Part vi., by J. C. VERCO, M.D., F.R.C.S. Dr. Verco exhibited specimens of shells—mostly of small size—obtained from deep dredgings off Cape Jaffa, Beachport, and outside the Neptunes, and enlarged drawings of some of the more interesting of these shells by Dr. Pulleine. Dr. Verco gave some interesting extracts from the paper.

MR. HOWCHIN thanked the President for the information he had given them, and directed the attention of the meeting to two points of considerable importance brought out by these studies of shells—first, the reduction in the number of species, by comparing the specimens obtained from various localities, which proved them to be synonymic; and in the second place the light they may throw on the age of geological formations, particularly the age of the various members of the Cainozoic series.

ORDINARY MEETING, SEPTEMBER 3, 1907.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

NOMINATIONS.—Noel A. Webb, barrister, of Adelaide, and H. A. Sweetapple, medical practitioner, of Parkside, as Fellows, and Herbert Basedow, science student, at present in Germany, as a Corresponding Member.

BALLOT.—Robert Thomson Melrose, of Mount Pleasant, sheepfarmer, was elected a Fellow.

AUDITORS.—J. S. Lloyd, F.I.A., S.A., and Stirling Smeaton, B.A., C.E., were elected Auditors.

EXHIBITS.—A. H. C. ZIETZ, F.L.S., exhibited a dark concretion of tubular form similar to the sandpipes which form round roots in sandy districts. The specimen, sent by Mr. R. F. Purdue, was found in the tindrifts at Gladstone, Tasmania, close to Purdue's tinmines (alluvial), forty feet from the surface. W. H. SELWAY, an *Acianthus caudatus*, from near the Square Waterhole. J. McC. BLACK, a *Sprengelia incarnata* of peculiar form from the same district.

PAPERS.—R. S. ROGERS, M.A., M.D., read a note descriptive of a new species of Orchid, *Caladenia tutelata*. "Notes on South Australian Marine Mollusca, with Description of New Species," Part vii., by J. C. VERCO, M.D., F.R.C.S.

THE ANNUAL MEETING, OCTOBER 1, 1907.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—Dr. H. A. Sweetapple and Noel A. Webb, solicitor, both of Adelaide, were elected Fellows. Herbert Basedow, science student, during his absence from Adelaide, was elected a Corresponding Member.

The Annual Report and Balance-sheet were read and adopted.

Election of Officers.—J. C. Verco, M.D., F.R.C.S., was elected President; Prof. E. H. Rennie, M.A., D.Sc., and Rev. Thomas Blackburn, B.A., Vice-Presidents; Walter Rutt, C.E., Honorary Treasurer; Samuel Dixon and W. H. Selway, the retiring members of Council, were re-elected, and Dr. R. S. Rogers, M.A., was elected a member of Council in the place of Dr. Cleland, who had resigned.

J. S. Lloyd, F.I.A., S.A., and Stirling Smeaton, B.A., were elected Auditors for the ensuing year.

Exhibits.—Mr. J. McC. Black, a specimen of *Helichrysum tepperi*, a rare and graceful Composita, which has been found in Morialta Gully and at Mulgundawa and Dublin. Its close relation to *Podolepis sessoni* and *P. siemssenia* were pointed out, and it was suggested that it should rather be placed among the genus *Podolepis* than in that of *Helichrysum*.

The following notice of motion was given by Dr. Rogers:—"That the Government be asked to provide funds for the appointment of a Government Botanist, with the special object of obtaining an expert knowledge of the endemic vegetation of this State for economic purposes."

Papers.—"The Secondary Radiation due to Beta Rays," by Prof. W. H Bragg, M.A., F.R.S., and J. P. V. Madsen, B.Sc. "*Diuris parachila* (sp. nov.), et *Caladenia gladiolata* (sp. nov.)," by R. S. Rogers, M.A., M.D. "Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species" (xxxvii.), by Rev. Thos. Blackburn, B.A.

ANNUAL REPORT, 1906-7.

The Council of the Society is pleased to report a successful year's work. This is evidenced by the papers and exhibits brought before the Society. It would appear, too, that increasing interest is being taken in its work by the public, a fair number of whom attend the monthly meetings as visitors.

Ten members have been elected, a larger number than for some years past.

The membership of the Society consists at the present time of 9 Honorary Fellows, 73 Fellows, 4 Corresponding Members, and 2 Associates.

Resignations have been received on the plea of inability to attend the meetings. It may be pointed out that every member of the Society is directly aiding scientific research, whether or not he attends meetings.

Requests for the Society's publications are constantly being made by scientific societies in Europe and America, and so every year the list of exchanges is increasing, and the library getting larger and becoming more valuable to those interested in scientific work.

The additions to the Institute Buildings were completed in June last, and declared open at an entertainment given by the Board of Governors of the Public Library, etc., on the 12th of that month. At this function it was announced that the large western room on the ground floor (in which this meeting is now being held) was granted to the Royal Society. Since then the allocation has been officially made by the Board.

It is anticipated that the Government will furnish the room with a complete set of shelves for the accommodation of the library.

If it can be arranged it is proposed that the work of Secretary and Librarian shall be made the work of one person, who shall be paid for his services, and who shall act in these capacities for both this and for the Royal Geographical Society.

The obituary for the year includes the names of two life members, the Hon. David Murray, who joined the Society in 1859, and Ebenezer Cooke, the late Commissioner of Audit, also H. C. Russell, an Hon. Member, and late Government Astronomer of New South Wales; David Fleming, Fellow, and some time Chairman of the Microscopical Section, and John Dennant, F.G.S., an Honorary Fellow, who died on June 13 of this year.

Mr. Dennant, a resident of Victoria, was elected in December, 1888, and for nearly thirty years has been an active member of the Society. His first contribution appeared in the Transactions of the Society in October, 1888, in a paper entitled "Notes on the Muddy Creek Beds, with Brief Remarks on other Tertiary Strata of South-Western Victoria." Some years later Mr. Dennant was associated with Professor Tate in compiling three papers on "The Correlation of the Marine Tertiaries of Australia." The interest each had in this work naturally drew Dennant and Tate together, and thenceforward they became friends and fellow

workers until the death of the latter. Subsequently Mr. Dennant made a special study of the fossil corals, resulting in the communication of seven consecutive papers on "Descriptions of New Species of Corals from the Australian Tertiaries," illustrated by well-executed plates. This work led up to an examination of recent corals, on which he contributed two papers, "Recent Corals from the South Australian and Victorian Coasts," and on "Madreporaria from the Australian and New Zealand Coasts." Mr. Dennant was regarded as an authority in Australasia in this department of science. Corals dredged in deep water off the coast of New South Wales by Messrs. Hedley and Peters, off the New Zealand coast by Mr. H. Sutuer, and off the South Australian coast by Dr. Verco, were forwarded to him for examination. His removal will be a loss to science. It is hoped some other member will be found to continue the work Mr. Dennant was doing so well. A letter of sympathy and condolence was sent by the Council to Mrs. Dennant.

The resignation of Dr. W. L. Cleland as a member of Council has been received with great regret. Dr. Cleland was elected a Fellow in 1879, and has been on the Council for twenty-four years, for fourteen of which he acted as Secretary, and for three years was President.

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED)

Dr	£	s.	d.	£	s.	d.
October 1st, 1906.						
To Balance				263	11	3
,, Subscriptions—						
Royal Society	77	3	0			
Field Naturalists' Section ...	25	0	0			
Malacological Section	2	5	0			
Microscopical Section ...	8	17	6			
				113	5	6
,, Donation—						
Dr. Verco, to illustrate "Transactions"				26	16	0
,, Government Grants—						
On Subscriptions	83	16	8			
For Printing Reports upon Scientific Investigations in South Australia	150	0	0			
				233	16	8
,, Sale of "Transactions"				1	0	6
,, Bank Interest				7	10	11
				£646	0	10

Cr.	£	s.	d.	£	s.	d.
By "Transactions"—						
Printing	196	1	6			
Illustrating	55	9	6			
Publishing	17	17	9			
Indexing	10	0	0			
				279	8	9
,, Grants—						
Field Naturalists' Section ...	12	0	0			
Microscopical Section ...	9	0	0			
				21	0	0
,, Library—						
Cataloguing	7	17	6			
Carriage on Books	0	8	6			
				8	6	0
,, Wages—						
Caretaker	3	0	0			
Moving Furniture	3	15	8			
				6	15	8
,, Printing, Postage, and Stationery				7	9	1
,, Exchange on Cheques				0	1	6
,, Conversazione				2	5	6
,, Advertising				2	18	9
,, Balance in Savings Bank ...				317	16	4
				£646	0	10

WALTER RUTT, Treasurer.

Adelaide, October 1st, 1907.

Audited and found correct,

J. S. LLOYD, S. SMEATON, } Auditors.

DONATIONS TO THE LIBRARY

For Year 1906-7.

TRANSACTIONS, JOURNALS, REPORTS, ETC.

Presented by the respective Editors, Societies, and Governments.

Austria and Germany.

Berlin—Königl. Preuss. Meteor. Instituts, Veröffentlichungen der Ergebnisse des; Niederschlagsbeobachtungen, 1903; Bericht für 1906.

——— Königl. Preuss. Akademie der Wissenschaften zu Berlin, Sitzungsberichte, 1906, Nos. 39-53; 1907, Nos. 1-38.

——— Deutsches Meteorologisches Jahrbuch, 1905, Heft 1, 2. Gesellschaft für Erkunde, Zeitschrift der, 1906, Nos. 7-10; 1907, Nos. 1-6.

——— Berliner Gesellschaft für Anthrop., Ethnol. und Urgeschichte. Ergänzungsblätter zur Zeitschrift für Ethnologie, Jahrgang 38, Heft. 4-6; Jahrgang 39, Heft 1-3.

——— Deutsche Entomologische Zeitschrift, 1881, Heft 1, 2; and each year to 1906; 1907, Heft 1-4.

——— Inhaltsverzeichniss, 1881-99, Catalog der Coleopteren von Sibirien, 1880-81, 1893, 1899.

——— Deutsche Entomologische Gesellschaft—An Account of Professor Dr. Gustav Kraatz, founder of the above Society.

——— Deutsch Südwestafrika und British Bechuanaland, Report for Year 1906.

Freiburg—Naturforschenden Gesellschaft zu Freiburg, Berichte der, Band xli.

Giessen—Oberhessischen Gesellschaft für Natur-Heilkunde, Berichte der, Band i. (1904-6), Band ii.

Göttingen—Königl. Gesellschaft der Wissenschaften zu Göttingen, Math. Phys. Klasse, Nachrichten der, 1906, Heft 3-5; 1907, Heft 1-3. Geschäftliche Mittheilungen, 1907, Heft 1.

Hamburg—Mitteilungen aus dem Naturhistorischen Museum, Jahrgang 1-23, 1885-1905.

Heidelberg—Berichte über Land- und Forstwirtschaft in Deutsch Ostafrika, Band iii., Heft 1, 2

Kiel—Naturwissenschaftlichen Vereins für Schleswig-Holstein, Schriften des, Band xiii., Heft 1, 2.

München—Sitzungsberichte der K.B. Akademie der Wissenschaften zu München, Math. Phys. Klasse, 1906, Heft 2, 3; 1907, Heft 1. Abhandlungen; Band lxxvi.

——————— Zeitschrift für das gesamte Schiess- und Sprengstoffwesen, Jahrgang 1, No. 17.

Nürnberg—Naturhistorischen Gesellschaft zu Nürnberg, Abhandlungen der, Band xi., Heft 3. Report for year 1904.

Vienna—Kaiserliche Akademie der Wissenschaften in Wien, Sitzung der Math. Naturwiss., Jahrgang 1907, Nos. 6-13, 14-17.

——— K.K. Gradmessungs Bureau, Astronomische Arbeiten d., Band xiv.

——— Verhandlungen der Oestreichischen Kommission für die Internationale Erdmessung, Dec., 1905.

——— Annalen des K.K. Naturhistorischen Hofmuseums, Band xx., No. 4; Band xxi., No. 1.

——— Verhandlungen der K.K. Geologischen Reichsanstalt, Jahrgang, 1906, Nos. 1-18; Jahrgang 1907, Nos. 2-10.

——— K.K. Zoologische Botanische Gesellschaft in Wien, Jahrgang 1907, Band lvi.; Jahrgang 1907, Band lvii., Heft 1-5.

Würzburg—Sitzungsberichte der Physikalisch-Medicinischen Gesellschaft zu Würzburg, 1906, Nos. 1-7.

Australia and New Zealand.

Adelaide—Public Library, Museum, and Art Gallery, Annual Report, 1905-6.

——— School of Mines and Industries, Annual Report, 1906.

——— Department of Mines, Short Review, Half-year, to June 30, 1906.

——— Woods and Forests Department, Annual Progress Report, 1905-6.

——— Geological and General Reports, Northern Territory of South Australia, North-Western District, 1905, and Supplement to No. 55, 1906.

——— The Crown Lands Laws of South Australia for 1905.

——— Adelaide Philosophical Society, Natural History of South Australia, 1880.

——— Adelaide Chamber of Commerce, Annual Report, 1907.

——— Handbook of the South Australian Company, 1898.

——— Geological Report of the Stannary Hills Mines, by Dr. Logan Jack, F.G.S., 1907, presented by Mr. Sam. Dixon.

Brisbane—Queensland Department of Mines, Geological Survey, Publications 201, 203, 205, 207-213.
——— Queensland Flora, vol. xvi., parts 7-9; vol. xvii., parts 1, 2, 3, 5, 6; vol. xviii., parts 2, 3.
——— Annals of the Queensland Museum, No. 7. The Weeds and Suspected Poisonous Plants of Queensland, parts 1-15, pages 1-246.
Geelong—Geelong Naturalist, vol. iii., Nos. 1-3.
Melbourne—Victoria Department of Agriculture, Journal, vol. iv., part 12; vol. v., parts 1-9.
——— Department of Mines, Bulletins Nos. 21, 22. Memoirs, 1907, Nos. 4, 5. Special Report.
——— Department of Mines, Geological Survey Records, vol. i., part 4.; vol. ii., part 1. Bulletins, 1907, Nos. 19, 20.
——— Mines and Water Supply, Annual Report, 1906.
——— Victorian Yearbook, 1905.
——— Royal Society of Victoria, Proceedings, vol. xix., New Series, part 2.
——— Victorian Geographical Journal, vol. xxiii., xxiv., 1905-6.
——— Victorian Naturalist, vol. xxii., No. 12; vol. xxiii., Nos. 7-11; vol. xxiv., Nos. 1-5.
Hobart—Royal Society of Tasmania, Papers and Proceedings, 1903-5.
Launceston—Department of Mines, Progress Reports, September, 1906, to June, 1907.
——— The Tasmanian Naturalist, vol. i., No. 1.
Perth—Meteorological Observations, 1905.
——— Department of Mines, Report, 1906.
——— Western Australian Natural History Society, Journal, No. 3, Catalogue of Books.
——— Geological Survey Bulletin, Nos. 24-26, 1907; No. 5, 1900.
——— Government Gazette, Supplement to, June to December, 1905, Nos. 40, 43, 47, 54, 59, 76, 1906; Nos. 2, 4, 10, 16, 19, 22, 29, 37, 41, 49, 1907.
——— Perth Catalogue of Standard Stars 31° and 41° S., 1905.
——— The Next International Scheme, vol. lxv., No. 9, a Suggestion by W. Ernest Cooke.
Sydney—Department of Mines, Annual Report, 1906.
——— Department of Mines and Agriculture, Agricultural Gazette, vol. xvii., part 12; vol. xviii., parts 1-9. Supplement to vol. xvii. Miscellaneous Publication No. 1040.

Sydney—Department of Mines, Records of the Geological Survey, vol. viii., part 3, 1907.
——— Royal Society of New South Wales, Journal and Proceedings, vols. xxxvii., xxxviii., 1903-5; vol. xl., September and December, 1906.
——— Linnean Society, Proceedings, vol. xxxi., parts 3, 4, No. 123; vol. xxxii., part 1, No. 125; part 2, No. 126.
——— An Aroid New for Australia, by J. H. Maiden, Australian Museum, Report the 51st, 1905; 52nd, 1906. Memoirs, No. iv., part 10. Records, vol. vi., parts 4, 5. Nests and Eggs of Birds found Breeding in Australia, by A. J. North, vol. ii., parts 1 and 2.
——— Public Library, Report of Trustees, 1906, 1905.
——— Botanic Gardens and Domain, Report, 1906.
——— Botanic Gardens, Biographical Notes, Section D, Address by the President.
——— New South Wales Naturalists' Club, vol. i., parts 4, 5.
——— Fisheries of New South Wales, Report of Commissoners, 1905, 1906.
——— Fishes of Australia.
——— The Forest Flora of New South Wales, vol. ii., parts 11-20; vol. iii., parts 2-6.
——— Sydney University Calendar, 1906-1907.
——— Royal Anthropological Society of Australia, Journal, vol. viii., No. 5; vol. ix Nos. 1-6, 8, 9. A List of Cyclophoridæ found in Australia, New Guinea, and adjacent groups of Islands, by J. C. Cox, M.D.
Auckland—Auckland Institute and Museum, Annual Report, 1906-7.
Christchurch—Canterbury Museum, Records, vol. i., No. 1.
Wellington—Special Reports on Educational Subjects. New Zealand Geological Survey, North-west Mines, Bulletin Nos. 2, 3.
——————— Catalogue of Plants of New Zealand.

Belgium and Holland.

Brussels—Société Entomologique de Belgique, Annales de la, tome l.
——— Société Royale de Botanique de Belgique, Bulletin, 1904-5.
——— Musée Royale d'Histoire Naturelle de Belgique, Memoires, tome iii., 1906.
——— Le Mouvement Sociologique International, Publication No. 83

Liège—Société Royale des Sciences, Memoires, 3rd Series, tome vi.

Amsterdam—Naturkundig Tydschrift voor Nederlandsch-Indie, deel lxvi.

Canada.

Halifax—Nova Scotian Institute of Sciences, Proceedings and Transactions.

Ottawa—Canadian Department of the Interior, Hamilton Sheet, Kluanee Sheet. Geological Survey, Annual Report, Palæontology, etc., vol. iii., part 4; vol. xv., 1902-3; 1901, and Maps, 1904, 1905, 1906; Preliminary Report and Summary Report. Maps, Nos. 59-65; 74-76; 82-83.

England, Ireland, and Scotland.

London—Conchological Society, Journal, vol. xi., No. 12; vol. xii., Nos. 1-3.

——— Entomological Society, Transactions, 1902, 1906.

——— Royal Colonial Institute, Proceedings, vol. xxxi., No. 4. Report, vol. xxxviii., 1906-7.

——— Linnean Society, Proceedings, 1906. List of Members, 1906-7.

——— Royal Society of London, Year Book, 1907. Proceedings Mathematical and Physical Sciences, vol. Alxxviii., Nos. A524-526; vol. Alxxix, Nos. A527-532.

——— Biological Sciences, Series B., vol. lxxviii., No B526; vol. lxxix., Nos. B527-533.

——— Royal Microscopical Society of London, Journal, 1906, parts 5, 6; 1907, parts 1-4.

——— National Physical Laboratory, Report, 1906. Collected Researches, vol. ii.

——— Royal Gardens, Kew, Bulletin, 1906.

——— The State Correspondent, etc., vol. xii., No. 10; vol. xiii., Nos. 2-8.

——— The Periodical, 1905, No. 32; 1906, Nos. 34, 36, 37; 1907, Nos. 38-40.

——— The British Association, Report, for each year from 1831 to 1884 (from the Engineer-in-Chief's Department, S. Aus.).

——— Gordon's Tomb and Golgotha, by A. W. Crawley-Boevey, M.A., Bombay Civil Service, Barrister-at-law.

Liverpool—Biological Society, Proceedings and Transactions, vol. xx., 1905-6.

Manchester—Literary and Philosophical Society, Memoirs and Proceedings, vol. li., parts 1-3.
——————— Geological Society, Transactions, vol. xxviii., part 16.
——————— Field Naturalists' and Archæologists' Society, Report and Proceedings, 1906.
Cambridge—Philosophical Society Proceedings, vol. xiii., part 6; vol. xiv., parts 1, 2.
——————— University Library, Report of Library Syndicate, 1906.
Belfast—Natural History and Philosophical Society, Report and Proceedings, 1905-6.
Dublin—Royal Dublin Society, Economic Proceedings, vol. i., parts 8, 9. Scientific Proceedings, vol. ii., Nos. 10-12. Scientific Transactions, vol. ix., parts 4, 5.
——— Royal Irish Academy, Proceedings, vol. xxvi., section A, Nos. 1, 2; sections B, Nos. 4-9; section C, Nos. 5-16; vol. xxvii., section A, Nos. 1, 2. Abstract of Minutes, 1905-6.
Edinburgh—Royal Physical Society, Proceedings, vol. xvi., pp. 267-435; vol. xvii., pp. 65-80, 81-120. Sessions 1899, 1902.
——————— Royal Society of Edinburgh, Proceedings. vol. xxvi., pp. 193-575; vol. xxvii., pp. 1-160.
——————— Geological Society, Transactions, vol. viii., special part; vol. viii., parts 1, 2.

France.

Caen—Société Linnéenne de Normandie, Bulletin, series 5, vol. ix., 1905.
Nantes—Société des Sciences Naturelles de l'Ouest de la France, Bulletin, tome vi., Nos. 1-3.
Paris—Société Entomologique de France, Bulletin, 1906, Nos. 15-21; 1907, Nos. 1-12; Annales, 1903, Nos. 1-4; 1904, Nos. 1-4; 1905, Nos. 1-4; 1906, Nos. 1-4; 1907, Nos. 1 and 2. Publications, tome ii.
——— La Feuille des Jeunes Naturalistes, Nos. 432-443.

Italy.

Florence—Società Entomologica Italiana, Bulletino della, xxxvii., trim. 1-2.
Milan—Società Italiana di Scienza Naturali e del Museo Civico de Storia Naturale in Milano, vol. xlv., fasc. 3, foglio $6\frac{3}{4}$; vol. xlvi., fasc. 1, fog. $5\frac{3}{4}$; General Index, 1906.

Pisa—Società Toscana di Scienza Naturali, Memorie, vol. xxii.; Processi Verbali, vol. xv., No. 5; vol. xvi., Nos. 1-3.

India.

Calcutta—Imperial Department of Agriculture, Annual Report.
——— Board of Scientific Advice, Annual Report, 1905-6.
——— Department of Agriculture in India, Memoirs, 1906, vol. i., Nos. 1-3; vol. i., No. 4. Botanical Series, 1907, vol. i., Nos. 3-5. Entomolog. Series, vol. i., Nos. 1, 2, 4. Chemical Series, vol. i., Nos. 5, 6. Botanical Series, vol. ii., No. 1.
——— Indian Museum, Investigator, 1906, part iii. The Alcyonarions of the Deep Sea. Annual Report, 1905-6.
Madras—Government Museum, Bulletin, vol. v., Nos. 2, 3. From the Annals and Magazine of Natural History, 1906, series 7, vol. xviii. Ethnographic Notes of Southern India, 1906.
Pusa—Agricultural Research Institute, Bulletin, 1906, No. 4. First Report on Fruit Experiments.

Japan.

Kyóto—Imperial University Calendar.
Tokyo—Imperial University of Tokyo, College of Science Journal, vol. xxi., art. 2-6; vol. xxii.
——— Seismological Society, Earthquake Investigation Committee, Publication No. 22, art. 1-4, Nos. 23, 24; Bulletin, vol. i., Nos. 2-4.
——— Asiatic Society of Japan, Transactions, vol. xxxiv., parts 1-4.

Mexico.

Mexico—Sociedad Cientifica, Memorias y Revista, tomo 22, num. 7-12; tomo 23, num. 5-12; tomo 24, num. 1-5.
——— Instituto Geologico de Mexico, Boletin del, num. 22, 24.

Norway and Sweden.

Bergen—Museums Aarbog, 1905, Hefte 2; 1906, Hefte 2, 3; 1907, Hefte 1, 2; Aarsberetning, 1906.
——— Bergens Museum, Meersfauna von Bergen, Hefte 2, 3.
Christiania—Sundry Geological Problems, by G. Henricksen, Inspector of Mines, Christiania, 1906.

Stockholm—Entomologisk Tidskrift; Arg. 26, Hefta 1, 2. Arg. 27, Hefta 3, 4.
——— Geologiska Föreningens Förhandlingar, Band. xxxii., 1906; Band. xxviii., Hefte 1.
——— Kongelige Vitterhets Historie och Antiquitets Akademiens Manadsblad, 1903-5.
——— A Short Handbook on Sweden, 1906.
——— Fornvännen, Meddelanden fran K. Vitterhetshistorie och Antikvitets Akademie, 1906.
Stavanger—Museum, Aarshefte, 16de Aargang, 1905.
Trondhjem—Kongelige Norske Videnskabs Selskabs Skrifter, 1905.
——— Carl von Linnés Forbindelse med Norge af Ove Dahl, 1907.

RUSSIA.

St. Petersburg—Academie Impériale des Sciences de St. Petersbourg, Bulletin, Classe Historico-Philo; 1904-1907, series 5, tome xxi.. No. 5; tome xxii., Nos. 1-5; tome xxiii., Nos. 1-5; tome xxiv., Nos. 1 and 2; 1907, series 6. Nos. 1-11.
——— Comité Géologique, Bulletins. tome xxii., Nos. 2, 4; tome xxiii., Nos. 7-10. Memoires, tome xxii., liv. 6, 7, 9, 12, 18, 19; tome 20, liv. 2; tome 15, liv. 1.
——— Russischen Kaiserlichen Mineralogischen Gesellschaft zu St. Petersburg, Verhandlungen der, 1905; series 2, 1906.
——— Materialen zur Geologie Ruslands. Herausgegeben von der Kaiserlishen Mineralogischen Gesellschaft, Band. xxiii., lief 1.
Kiev—Société des Naturalistes de Kiev, Memoires, tome xx., liv. 2, 1906.
Moscow—Société Imperiale des Naturalistes de Moscow, Bulletin No. 4, 1905; Nos. 1, 2, 1906.

FINLAND.

Finland—Der Geographische Verein in Finland, Meddelanden af Geog. Föreningen, 1904-6.

SWITZERLAND.

Geneva—Société de Physique et de Histoire Naturelle, Compte rendu des Scéances, xxiii., 1906.
——— L'Institut National Genevois, Bulletin, vol. xxxvii.
Lausanne—Société Vaudoise des Sciences Naturelles, Bulletin, vol. lii., Nos. 156, 157; vol. liii., No. 158.
Meteor: Observations faites au Champ-de l'Air.

Neuchatel—Société Neuchateloise des Sciences Naturelles, Bulletin, tome xxxii., year 1903-4.
Zürich—Annotationes Concilii Bibliographici, vol. ii., anno. 1906.

South and Central America.

Lima—Cuerpo de Ingenieros de Minas de Peru, Boletin del, Nos. 37-46. Secunda Memoria, 1904-5.
Monte Video—Museo Nacional, Anales, tomo iii., entrega i.
Rio de Janeiro—Observario do Rio de Janeiro, Boletin Mensal, 1905-1906.

South Africa.

Albany—Museum, Records, vol. ii., part 1.
Cape Town—South African Museum, Report, 1906.
——————— South African Association for the Advancement of Science, Reports for years 1905, 1906.
——————— South African Philosophical Society, Transactions, vol. xv., part 5, 1905; vol. xiii., part 2; vol. xvi., parts 4, 5; vol. xvii., part 1.
Natal—South African Surveyor-General's Department, Report, third and final.

Sandwich Islands.

Honolulu—The Bernice Pauahi Bishop Museum, Occasional Papers and Report, 1906, vol. iv., No. 1; vol. iii., No. 1; 1907, vol. ii., No. 5. Directors' Report, with Index to vol. ii.

United States of America.

Baltimore—John Hopkins University, Circulars, Nos. 3-9. History and Political Science, series xxiv., Nos. 3-10. American Chemical Journal, vol. xxxv., Nos. 5, 6; vol. xxxvi., Nos. 1-6; vol. xxxvii., Nos. 1, 5.
Boston—Society of Natural History, Proceedings, vol. xxxii., Nos. 3-12 and index; vol. xxxiii., Nos. 1-12.
——— American Academy of Arts and Sciences, Proceedings, vol. xli., No. 35; vol. xlii., Nos. 2-18.
——— University of California, Pubs. Zoology, vol. iii., No. 2, pp. 13-38, plates 3-7; do., do., American Archæology and Ethnology, vol. iv., Nos. 1-2. College of Agriculture, Nos. 177, 178.

Cambridge—Museum of Comparative Zoology, Harvard College, Report, 1905-6; Geological Series, Bulletins, vol. xliii., No. 5; vol. xlix.; vol. l., Nos. 4 and 5, 8, 9; vol. li., Nos. 1-4.

Chicago—Field Columbian Museum, Geological Series, vol. ii., Nos. 8, 9; vol. iii., Nos. 3, 4. Zoological Series, vol. vii., Nos. 2, 3.

Indiana—Academy of Science, Proceedings, 1906.

Kansas—Kansas University, Bulletin, vol. vi., No. 2; vol. vii., No. 3.

——— The University Geological Survey of Kansas, Bulletin, 1903-1904, vol. viii.

Massachusetts—Tufts College Studies, vol. ii., No. 2

Missouri—Missouri Botanical Gardens, Annual Report, 1906.

New York—Public Library, Bulletin, vol. ix., No. 2; vol. x., Nos. 9-12; vol. xi., Nos. 1-7.

——————— Studies from the Rockefeller Institute for Medical Research, vol. v., 1906.

——————— American Museum of Natural History, Journal, vol. vi., No. 3. Memoirs, Whole Series, vol. vi., part 1; vol. v., part 3; vol. x., part 1; vol. xiv., part 1. Memoirs, Geological Fossils, 1904, vol. ii, part 1; 1905, vol. iv., part 5; 1906, vol. viii., part 1; 1907, vol. iv., part 6. Guide Leaflets, Nos. 24, 25. Academy of Sciences, Annals, vol. xvi., part 3; vol. xvii., part 1.

——————— The Museum of the Brooklyn Institute of Arts and Sciences, vol. i., Nos. 4, 8, 9.

——————— Cold Spring Harbour Monographs, No. 6.

——————— Carnegie Institution of Washington, Zoological Experimental do., do., Nos. 4-7, Yearbooks, No. 5, 1906.

——————— American Museum, Journal, vol. vi., No. 4; vol. vii., Nos. 1, 2, 4, 5.

——————— The Journal of Geography, vol. v., No. 8.

Ohio—Wilson Bulletin, Oberlin College Library, Nos. 56, 57.

———Scientific Laboratories, Denison University, Granville, Bulletin, vol. xiii., art 3.

Philadelphia—Academy of Natural Sciences, Proceedings, vol. lviii., parts 1, 2.

——————— American Philosophical Society, Proceedings, vol. xlv., Nos. 182, 183; Transactions, vol. xxi., part 3.

——————— The Philadelphia Commercial Museum, Report, 1898.

St. Louis—The Academy of Science of St. Louis, Transactions, vol. xvi., Nos. 1-7.

Washington—Smithsonian Institution, U.S. National Museum, Bulletin, No. 39, parts P and Q; No. 56, part 1. Proceedings, vols. xxx., xxxi. Contributions, vol. x., parts 3, 4; vol. xi., part 1. Annual Report, 1905, 1906. Annual Report of Board of Regents, 1905. Bureau of American Ethnology, Bulletin, No. 32.

———————— United States Geological Survey, Professional Papers, series A, B, C, No. 51, A70, B87, B77, 049, C77; No. 52, B89, 055; No. 54, A76, B95; Nos. 51, 55.

———————— Department of the Interior, Annual Report, No. 26; Bulletin, Nos. 283-285, 289, 290, 292, 293, 295, 298, 299, 301, 302.

———————— Water Supply and Irrigation, Paper, Nos. 119, 154, 157, 159-162, 165, 167, 169, 171, 172, 174, 175, 177, 179-181, 184-186.

———————— Topographic Maps, folios 136-140.

———————— Academy of Sciences, Proceedings, vol. viii., pp. 167-403, 407-491; vol. ix., pp. 1-274.

Philippine Islands—Manilla, The Far Eastern Review, vol. iv., No. 1.

Trenton—New Jersey, Archæologia Nova Cæsarea, by Charles Conrad Abbott, M.D.

Urbana—Illinois State Laboratory of Natural History, Bulletin, vol. vii., articles 6-9.

LIST OF FELLOWS, MEMBERS,

ETC.,

OCTOBER, 1907.

Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in the address should be notified to the Secretary.

Date of Election

Honorary Fellows.

1893. *Cossman, M., Rue de Maubeuge, 95, Paris.
1897. *David, T. W. Edgeworth, B.A., F.R.S., F.G.S., Prof. Geol., Sydney University.
1876. Ellery, R. L. J., F.R.S., F.R.A.S., Gov. Astron., the Observatory, Melbourne, Victoria.
1890. *Etheridge, Robert, Director of the Australian Museum of New South Wales, Sydney.
1905. Gill, Thomas, I.S.O., Under-Treasurer, Adelaide.
1905. *Hedley, Chas. H., Naturalist, Australian Museum, Sydney.
1892. *Maiden, J. H., F.L.S., F.C.S., Director Botanic Gardens, Sydney, New South Wales.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Prof. of Anatomy, Sydney University.

Corresponding Members.

1881. Bailey, F. M., F.L.S., Colonial Botanist, Brisbane, Queensland.
1907. *Basedow, Herbert, Breslau University, Germany.
1880. *Foelsche, Paul, Inspector of Police, Palmerston, N.T.
1893. Stretton, W. G., Palmerston, N.T.
1905. Thomson, G. M., F.L.S., F.C.S., Dunedin, New Zealand.

Fellows.

1895. *Ashby, Edwin, Royal Exchange, Adelaide.
1902. *Baker, W. H., Glen Osmond Road, Parkside.
1907. Black, J. McConnell, Alfred Street, Norwood.
1887. *Blackburn, Rev. Thomas, B.A., Woodville.
1886. *Bragg, W. H., M.A., F.R.S., Prof. of Mathematics and Physics, University of Adelaide.
1905. Brookman, George, North Gilberton.
1882 Brown, H. Y. L., F.G.S., Gov. Geologist, Adelaide.
1893. Brummitt, Robert, M.R.C.S., Gilberton.
1904. Brunkskill, George, Semaphore, S.A.
1906. Bundey, Miss Ellen Milne, 148, Molesworth Street, North Adelaide.
1907. Chapman, R. W., M.A., B.C.E., Prof. of Engineering, University, Adelaide.
1904. Christie, William, Adelaide.
1879. *Cleland, W. L., M.B., Ch.M., J.P., Colonial Surgeon, Resident Medical Officer Parkside Lunatic Asylum, Lecturer in Materia Medica, University of Adelaide.

1895. Cleland, John B., M.D., Perth, Western Australia.
1907. *Cooke, T. W., D.Sc., Lecturer, University, Adelaide.
1907. Darling, John, Kent Terrace, Norwood.
1887 *Dixon, Samuel, Bath Street, New Glenelg.
1902. Edquist, A. G., Hindmarsh.
1904. Gartrell, Jas., Burnside.
1904. Gordon, David, Gawler Place, Adelaide.
1880. *Goyder, George, A.M., F.C.S., Analyst and Assayer, Adelaide.
1896. Greenway, Thos. J., Adelaide.
1904. Griffith, H., Hurtle Square, Adelaide.
1896. Hawker, E. W., F.C.S., Adelaide.
1899. *Higgin, A. J., F.I.C., Assistant Lecturer on Chemistry, School of Mines, Adelaide.
1891. *Holtze, Maurice, F.L.S., Director Botanic Gardens, Adelaide.
1883. *Howchin, Walter, F.G.S., Lecturer on Geology and Palæontology, University, Adelaide.
1902. Iliffe, Jas. Drinkwater, B.Sc., Prince Alfred College, Kent Town.
1893. James, Thomas, M.R.C.S., Moonta.
1902. Jeffreys, Geo., Gilbert Place, Adelaide.
1900. *Johncock, Chas. F., Morphett Vale.
1897. *Lea, A. M., Gov. Entomologist, Hobart, Tasmania.
1884. Lendon, A. A., M.D. (Lond.), M.R.C.S., Lecturer on Forensic Medicine and on Chemical Medicine, University, Adelaide, and Hon. Physician, Children's Hospital, North Adelaide.
1856. Lloyd, J. S., Alma Chambers, Adelaide.
1888. *Lower, Oswald B., F.E.S. (Lond.), Broken Hill, New South Wales.
1905. *Mawson, Douglas, B.Sc., B.E., Lecturer on Mineralogy and Petrology, University, Adelaide.
1894. Mayo, Geo. G., C.E., Hon. Secretary, 116, Franklin St., Adelaide.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., Angas Street, Adelaide.
1907. Muecke, Hugo, C.E., Grenfell Street, Adelaide.
1884. Munton, H. S., North Terrace, Adelaide.
1883. Phillipps, W. H., Adelaide.
1886. Poole, W. B., Savings Bank, Adelaide,
1907. Pulleine, R. H., M.B., C.M., Adelaide.
1907. Purdue, R. F., Mining Agent, Launceston, Tasmania.
1904. Reissmann, Charles, M.A., M.D. (Cantab), B.Sc. (Lond.), etc., Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc. (Lond.), F.C.S., Professor of Chemistry, University of Adelaide.
1905. *Rogers, R. S., M.A., M.D., Flinders Street, Adelaide.
1869. *Rutt, Walter, Chief Assistant Engineer, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1893. Simson, Augustus, Launceston, Tasmania.
1857. Smeaton, Thomas D., Mount Lofty.
1900. Smeaton, Stirling, B.A., C.E., Engineer-in-Chief's Office, Adelaide.
1871. Smith, Robert Barr, Adelaide.
1881. *Stirling, Edward C., C.M.G., M.A., M.D., F.R.S., F.R.C.S., Professor of Physiology, University of Adelaide, Director of S.A. Museum.

1906. Snow, F. H., Mutual Chambers, Adelaide.
1907. Sweetapple, H. A., M.D., Park Terrace, Parkside.
1904. Taylor, William, St. Andrews, North Adelaide.
1886. *Tepper, J. G. O., F.L.S., Entomologist, S.A. Museum. (Corresponding Member since 1878).
1897. *Torr, W. G., LL.D., M.A., B.C.L., Brighton, South Australia.
1894. *Turner, A. Jefferis, M.D., Wickham Terrace, Brisbane, Queensland.
1902. Vandenbergh, W. J., F.R.S.L., F.R.S.E., F.R.M.S., J.P., Barrister and Solicitor, Pirie Street, Adelaide.
1889. Vardon, Joseph, J.P., Gresham Street, Adelaide.
1878. *Verco, Joseph C., M.D., F.R.C.S., Lecturer on the Principles and Practice of Medicine and Therapeutics, University of Adelaide.
1883. Wainwright, E. H., B.Sc. (Lond.), Wellington Road, Maylands.
1878. Ware, W.L., J.P., Adelaide.
1859. Way, Right Hon. Sir Samuel James, Bart., P.C., D.C.L., Chief Justice and Lieutenant-Governor of South Australia, Adelaide.
1907. Webb, Noel A., Barrister, Waymouth Street, Adelaide.
1904. Whitbread, Howard, Currie Street, Adelaide.
1902. *Woolnough, Walter George, D.Sc., F.G.S., University, Sydney, New South Wales.
1886. *Zietz, A. H. C., F.L.S., C.M.Z.S., Assistant Director South Australian Museum, Adelaide.

Associates.

1901. Collison, Miss Edith, B.Sc., Flinders Street, Adelaide.
1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDICES.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

TWENTY-FOURTH ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED SEPTEMBER 30, 1907.

Evening Meetings.

The monthly meetings of the Section, held during the winter months, have been well attended, and the exhibits numerous and instructive.

On October 16, 1906, Dr. Ramsay Smith gave an interesting lecture in the Prince of Wales Lecture Theatre (kindly lent by the University for the occasion) on his tour through Northern Australia and the East. The lecture dealt specially with the Australian aboriginals in their ethnology and customs, and was illustrated by a large number of excellent lantern slides.

November 20. Dr. R. S. Rogers, M.A., delivered the Chairman's Address, which had been unavoidably postponed. His subject was the work of Robert Brown, the Naturalist on board the "Investigator" with Flinders. The lecturer emphasized the debt which Australia owes to Brown, who amidst great difficulties collected and named a very great number of Australian plants.

April 16, 1907. Dr. Pulleine gave a lecture on "The Classification of Australian Birds," illustrated by a great number of specimens.

May 21. Papers were read supplying observations made during the Easter excursion to Kangaroo Island, as follows:— Dr. R. S. Rogers, on ichthiology; Mr. J. W. Mellor, ornithology; Mr. Griffiths, entomology; and Mr. W. H. Selway, on botany.

June 18. Mr. D. Mawson, B.E., B.Sc., gave an interesting account of his journey to Mount Kosciusko, "the roof of Australia."

July 16. Dr. H. Pulleine, on the "Classification of

Spiders," with their life history, habits, etc., illustrated by references to the common house and garden spiders.

August 20. Mr. J. G. O. Tepper. F.L.S., discoursed on "Natural History Objects of Common Interest," based on a miscellaneous collection of insects forwarded to him by an anonymous correspondent.

Excursions.

The first of the year was held on October 13 at Grenville Glen by invitation of Mr. G. J. Ireland, when an opportunity was afforded of exploring the sources of Brown Hill Creek at Crafers. The leading feature was the collection of botanical specimens which were in great profusion along the creek, a spot that is not much disturbed by man or beast.

Next followed the three days' excursion on November 10, 11, and 12, with Myponga as the rendezvous. This district is one of the best within comparatively easy reach of the city for botanical work. In this locality are to be found many rare specimens of interest not met with in the Mount Lofty Ranges. The party was comfortably provided for at private houses. On the second day after arrival the party was conducted to Lovely Valley, on the Yankalilla Road, and on the following day the swampy country was exploited, where collectors had an interesting time amongst both land and water plants. Orchid-hunters were particularly well favoured. This perhaps most interesting order of all our native flowers has become quite an interesting feature of all the field work since its special introduction by our late Chairman, Dr. Rogers, who is a recognized authority on the subject, and has described four new species and three new to the State, during the year, in the Transactions of the Royal Society of South Australia.

The annual picnic was held on December 15 at the National Park. Following the afternoon's enjoyment, the Chairman, Mr. J. McC. Black, invited the party to tea at the Belair Hotel.

During midsummer two marine excursions were arranged, which took place in February and March. The Port Adelaide River, as far as the Outer Harbour, was the selected ground for dredging operations. On these occasions members belonging to the Microscopical Section joined in the outing, and interesting results were obtained.

The Easter holidays were taken advantage of by a number of members, who arranged to visit Kangaroo Island. This was the first occasion upon which the section had gone so far afield. Penneshaw was made the centre for operations, and excursions were made to Antechamber Bay, the south coast, and Mount Thisbe, at the head of American River. The

special studies were ornithology, entomology, and botany. The collectors in each of these branches were amply repaid for the journeyings, and the Easter trip to Kangaroo Island will probably become an annual fixture.

May 4 found the members again in the field at Upper Sturt, taking the road *via* the National Park. The results obtained on this excursion were chiefly ornithological. It is gratifying to note that the native birds, whilst driven from the open by the extension of the areas of closer settlement, find in the park a secure retreat.

Hallett's Cove has special attractions for the naturalist, and on June 3 fifty members, with the Microscopical Section, journeyed thither for a whole day's excursion, which yielded points of interest in most departments of natural-history studies.

On June 15 the Mount Lofty district was again visited, the vicinity west of the railway station being explored. The district is the home of the *Epacris*, and the scrub was a beautiful profusion of red colourings from this favourite flower. Mr. T. D. Smeaton led the party on this occasion, and amongst many other observations drew attention to the geological formation of the hills, and the consequent peculiarities of their physical geography.

Athelstone, at the foot of the Black Hill, is a popular locality, and a good number travelled thither. It was suitable weather for climbing, and some of the members gained the summit of the hill. Botanists were particularly well rewarded in collecting early varieties of plants.

July 27 was the one day of the year's arrangements that could not be counted a success. The appointment was a walk across the swampy country from the Glenelg Railway to a ridge of pine forest on the Grange seacoast. The weather and the place were equally uninviting, and the few members who essayed the journey were disappointed with the result.

Blackwood easily holds the palm for botany of all the districts near to the city, and by the kind permission of Mr. C. Downer, the Craigburn Estate was traversed as far as time would permit, on August 17. Where the flowers are, there also are the insects and the birds, and the naturalists always enjoy a ramble in this district, for so much is to be observed.

For business purposes, the year for the Section closes on September 30, and the annual general meeting is held on the third Tuesday of the same month. The last excursion during the business year, therefore, was held on the holiday proclaimed for September 1. This gave the opportunity to hold a three-days' outing to Victor Harbour. The party left on

the Saturday afternoon, and broke the journey for a ramble in the Aldgate scrub, after which tea was arranged, and the train taken to complete the journey to the Harbour. It was eight years since the section had paid a visit to the place. On the second day they drove out towards Square Waterhole, where many rare things are to be found, and amply repaid for the visit. The third day a trip was taken to the glaciated pavement, known as "Selwyn's Rock." The coastline was not neglected by the members, and the excursion was regarded as a success.

From this summary of the evening- and day-work of the year it will be seen that the Section has had its time and opportunities fully and profitably occupied.

The members on the roll number 114. which is an increase of 10 for the year.

J. McC. Black, Chairman.
E. H. Lock, Hon. Sec.

NINETEENTH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE OF THE FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA, FOR THE YEAR ENDED SEPTEMBER, 1907.

In the past year some further work has been done with regard to the proposed Kangaroo Island reserve. On April 20, by arrangement made through Mr. T. H. Smeaton, M.P., the Chairman, Mr. Dixon, and Mr. Ashby, had an interview with the Premier, who intimated that, in consequence of the lessees of portion of the 300 square miles asked for demanding too high a price for the surrender of their holdings, the Cabinet could grant only the Cape Borda lighthouse reserve, containing 60 square miles. Regarding the trustees for the reserve, the Premier requested that a scheme for their appointment should be sent to him. Subsequently a letter was sent, on behalf of the committee, thanking the Premier for the promise of the 60 miles, suggesting that the Act constituting the park should provide for further extension to the area originally asked for, and recommending that the following divisions of natural history, namely, general zoology, ornithology, marine zoology, and botany, should be represented upon the Board of Trustees, one gentleman representing each division being nominated by the University, and one representing each division by the Royal Society. No reply has yet been received; but the committee hope that their suggestions may be adopted, and that mistakes such

as have been made in appointing the Board of the National Park be thus avoided. The committee is pleased to learn that the Crown lands in the districts of Barossa, Para Wirra, and Mount Crawford have been proclaimed a kangaroo district, and that kangaroos will be absolutely protected therein for a period of ten years. They have under consideration the question of recommending the proclamation of other districts.

The Committee is also glad to know that nature study is now to find a place in our public-schools curriculum, a course which they recommended at a deputation which waited upon the Minister of Education about fifteen years ago.

SAML. DIXON, Chairman.

Adelaide, September 17, 1907.

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Statement of Receipts and Expenditure for the Year ended September, 1907.

Dr. Receipts.	£	s.	d.	Expenditure.	£	s.	d.
Received from Secretary, October, 1906 ...	1	13	3	By Printing	4	9	6
To Subscriptions for 1906-7	26	2	6	,, Caretaker	1	10	0
,, Grant from the Royal Society, September 18, 1907	12	0	0	,, Advertising	0	10	0
				,, Minute-book and Envelopes	0	5	0
				,, Postages	5	7	3
				,, Subscriptions paid to Royal Society ...	25	0	0
				,, Balance	2	14	0
	£39	15	9		£39	15	9

Audited and found correct.

J. S. Lloyd,
Walter D. Reed, } Auditors.

S. Walters, Hon. Treasurer.

Adelaide, September 16, 1907.

MALACOLOGICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1906-7.

The work of revising the census of S.A. mollusca was continued, and the following is the revised list:—

Family STOMATIIDÆ.

53. Stomatella imbricata, Lamarck. Anim. S. Vert., 1822, vol. vi. (2), p. 209.

54. Gena nigra, Quoy & Gaimard *(Stomatella)*. Voy. Astrolabe, Zool., 1834, vol. iii., p. 307, pl. lxvi. bis, f. 10-12. *Stomatia (Gena) strigosa*, A. Adams.

55. Gena terminalis, Verco. Trans. Roy. Soc. S. Austr., 1905, vol. xxix., p. 166, pl. xxxi, f. 4-5.

Family TURBINIDÆ.

56. Turbo jourdani, Kiener. Rev. Zool., 1839, p. 324.

57. Turbo gruneri, Philippi. Zeits. fur Malak., 1846, p. 98, No. 6. *T. circularis*, Reeve.

58. Turbo undulatus, Martyn *(Limax)*. Univ. Conch., 1784, vol. i., f. 29; *L. anguis*, Martyn; *Simsoni*, Ten. Woods.

59. Turbo stamineus, Martyn *(Limax)*. Univ. Conch., 1784, vol. ii., f. 71. *T. torquatus*, Gmelin: *T. lamellosus*, Philippi.

60. Astralium fimbriatum, Lamarck *(Trochus)*. Anim. S. Vert., 1822, vol. vii., p. 12. *T. squamiferus*, Koch.

61. Astralium aureum, Jonas *(Trochus)*. Zeits. fur Malak., 1844, p. 168. *Carinidea granulata*, Swainson: *C. tasmanica*, Ten. Woods.

62. Astralium rutidoloma, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part i., p. 192, pl. 7, f. 9.

63. Leptothyra rosea, Ten. Woods *(Monilea)*. Proc. Roy. Soc. Tasm., 1876, p. 154. *Collonia roseo-punctata*, Angas.

64. Leptothyra josephi, Ten. Woods *(Cyclostrema)*. Proc. Roy Soc. Tasm., 1877, p. 147.

65. Leptothyra arenacea, Pritchard & Gatliff. Proc. Roy. Soc. Vict., 1902, vol. xiv. (n.s.), part ii., p. 181, pl. ix., f. 3.

66. Leptothyra carinata, Verco. Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., pl. xxix., f. 8.

Family PHASIANELLIDÆ.

67. Phasianella australis, Gmelin *(Buccinum)*. Syst. Nat., 1788, p. 3490, No. 173. *B. tritonis*, Chemnitz; *P. bulimoides*, Lam.; *P. varia*, Lam.; *P. decorata*, Chenu.; *picta*, De Blain; *lehmanni*, Menke; *preissi*, Menke; *venusta*, Reeve; *pulchella*, Ten. Woods; *delicatula*, Ten. Woods; *subsanguinea*, Tryon.

68. Phasianella ventricosa, Quoy & Gaimard. Voy. Astrolabe, 1834, vol. iii., p. 237, pl. lix., f. 8-9. *P. solida*, Desh.; *perdix*, Phil.; *brevis*, Menke; *turgida*, Phil.; *delesserti*, Chenu; *sanguinea*, Reeve; *zebra*, Reeve; *venosa*, Reeve; *reticulata*, Reeve.

69. Phasianella variegata, Lamarck. Anim. S. Vert., 1822, vol. vii., p. 53. *P. unifascialis*, Kiener; *nivosa*, Reeve; *fulgurata*, Reeve; *angasi*, Crosse; *splendida*, Phil.; *lineolata*, Wood; *viridis*, Anton; *rubens*, Lam.

70. Phasianella rosea, Angas *(Eutropia)*. Proc. Zool. Soc. Lond., 1867, p. 114, pl. xiii., f. 24.

71. Phasianella virgo, Angas *(Eutropia)*. Proc. Zool. Soc. Lond., 1867, p. 115, pl. xiii., f. 25.

Family DELPHINULIDÆ.

72. Liotia australis, Kiener *(Delphinula)*. Icon. Coq. Viv., 1839, vol. x., p. 8, pl. iv., f. 7.

73. Liotia clathrata, Reeve *(Delphinula)*. Proc. Zool. Soc. Lond., 1843, sp. 21.

74. Liotia subquadrata, Ten. Woods. Proc. Lin. Soc. N.S. Wales, 1878, vol. ii., p. 236.

75. Liotia mayana, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 227, pl. vi., f. 5a-5c. *L. discoidea*, Ten. Woods (non Reeve).

76. Liotia densilineata, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 228.

77. Liotia tasmanica, Ten. Woods. Proc. Roy. Soc. Tasm., 1876 for 1875, p. 153. *L. incerta*, Ten. Woods.

78. Liotia hedleyi, Pritchard & Gatliff. Proc. Roy. Soc. Vict., 1899, vol. xii., p. 105, pl. viii., f. 8, 9, 10.

79. Liotia alazon, Hedley. Records Austr. Mus., 1905, vol. vi., p. 49, f. 14.

Family CYCLOSTREMATIDÆ.

80. Cyclostrema inscriptum, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 216, pl. vii. f. 3 a and b.

81. Cyclostrema tatei, Angas. Proc. Zool. Soc. Lond., 1878, p. 862, pl. liv., f. 10.

82. Cyclostrema harriettæ, Petterd. Journ. of Conch., 1884, p. 141.

83. Cyclostrema homalon, Verco. Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., p. 305, pl. xxix., f. 3 and 4.

84. Cyclostrema pachyston, Verco. Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., p. 306, pl. xxix., f. 10.

85. Cyclostrema delectabile, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 216, pl. vii., f. 4.

86. Cyclostrema denselaminatum, Verco. Trans. Roy. S. Austr., 1907, vol. xxxi., p. 306, pl. xxix., f. 9.

87. Cyclostrema charopa, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 217, pl. vii., f. 2a-2c. *C. micra*, Petterd.

88. Cyclostrema angeli, Ten. Woods *(Rissoia* [?]). Proc. Roy. Soc. Tasm., 1877 for 1876, p. 153.

89. Cyclostrema crebresculptum, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 219, pl. vii., f. 5, probably only a variant of *C. angeli*, Ten. Woods.

90. Cyclostrema micron, Ten. Woods. Proc. Roy. Soc. Tasm., 1877 for 1876, p. 147.

91. Cyclostrema weldii, Ten.-Woods. Proc. Roy. Soc. Tasm., 1877 for 1876, p. 147. *C. susonis*, Ten. Woods; *Cirsonella australis*, Angas.

92. Cyclostrema contabulatum, Tate. Trans. Roy. Soc. S. Austr., 1899, vol. xxiii., p. 222, pl. vii., f. 6.

93. Lodderia lodderæ, Petterd *(Liotia)*. Journ. of Conch. Lond., 1884, p. 135, No. 2.

94. Pseudoliotia micans, A. Adams *(Cyclostrema)*. Proc. Zool. Soc. Lond., 1850, p. 43. *Liotia angasi*, Crosse; *Liotia speciosa*, Angas; *Liotia gowllandi*, Brazier; var. *gracilior*, Tate.

Family TROCHIDÆ.

95. Clanculus flagellatus, Philippi *(Trochus)*. Zeits. f. Malak., 1848, p. 105. *C. floridus*, Philippi.

96. Clanculus limbatus, Quoy & Gaimard *(Trochus)*. Voy. Astrolabe, 1834, vol. iii., p. 245, pl. lxiii., f. 1-6. *T. morum*, Philippi; *T. variegatus*, A. Adams.

97. Clanculus maxillatus, Menke *(Monodonta)*. Moll. Nov. Holl., 1843, p. 14.

98. Clanculus yatesi, Crosse. Journ. de Conch., 1863, p. 379, pl. xiii., f. 1; *C. conspersus*, A. Adams; var. *C. subdepressa*, Crosse; var. *philippi*, Koch; var. *aloysii*, Ten. Woods, *raphaeli*, Ten. Woods; var. *philomenæ*, Ten. Woods; var. *purpuratus*, Pilsbry.

99. Clanculus ringens, Menke *(Monodonta)*. Moll. Nov. Holl., 1843, p. 14.

100. Clanculus dunkeri, Koch *(Trochus* [*Monodonta*]). Abbild. Besch. Conch., 1843, vol. i., part iii., p. 67, pl. ii., f. 5. *C. rubens*, Adams & Angas.

101. Clanculus leucomphalus, Verco. Trans. Roy. Soc. S. Austr., 1905, vol. xxix., p. 168, pl. xxxi., f. 9, 10, 11.

102. Clanculus plebeius, Philippi *(Trochus)*. Conch. Cab., 1846, p. 326, pl. xlvi., f. 10. *C. nodoliratus*, A. Adams; *Gibbula multicarinata*, Ten. Woods; *C. angeli*, Ten. Woods; var. *consobrinus*, Tate.

103. Clanculus ochroleucus, Philippi *(Trochus)*. Conch. Cab., 1846, Band ii., Abt. ii., p. 243, pl. xxxvi., f. 16.

104. Clanculus euchelioides, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., p. 193, pl. i., f. 8.

105. Clanculus undatus, Lamarck *(Monodonta)*. Encyc. Meth., pl. ccccxlvii., f. 3 *a*, *b*. *Trochus smithii*, Wood.

106. Monodonta (Austrocochlea) constricta, Lamarck. Anim. s. Vert., 1822, vol. vii., p. 36. *Labio porcatus*, A. Adams; *Trochocochlea multi-carinata*, Chenu; *Trochus extenuatus*, Fischer; var. *tæniata*, Quoy & Gaimard; var. *zebra*, Menke.

107. Monodonta (Austrocochlea) striolata, Quoy and Gaimard. Voy. Astrolabe, 1834, vol. iii., p. 253, pl. lxiii., f. 18-22. *Labio fuligineus*, A. Adams; *Trochus concameratus*, Wood.

108. Monodonta melanoloma, Menke. Moll. Nov. Holl., 1843, p. 14, No. 50. *Labio corrosa*, A. Adams; *Diloma hectori*, Hutton; *Trochocochlea chloropoda*, Tate.

109. Diloma odontis, Wood. Index Test. Sup., 1828, p. 17, pl. vi., f. 37.

110. Diloma adelaidæ, Philippi. Conch. Cab., 1846, p. 140, No. 168, pl. xxiv., f. 1. *Gibbula depressa*, Ten. Woods; *Diloma australis*, Ten. Woods; *Gibbula tesserula*, Ten. Woods.

111. Cantharidus lehmanni, Menke *(Trochus)*. Moll. Nov. Holl., 1843, p. 18, No. 70. *Phasianella elegans*, Lamarck (non Gmelin); *Trochus pictus*, Philippi (non Wood); *T. ramburi*, Crosse; *T. lesueuri*, Fischer.

112. Cantharidus pulcherrimus, Wood *(Trochus)*. Index Test., Sup., 1828, p. 18, pl. vi., f. 45. *Trochus preissii*, Menke; *Thalotia mariæ*, Ten. Woods.

113. Thalotia conica, Gray *(Monodonta)*. King's Austr. Survey, App., 1827, vol. ii., p. 479, No. 28. *Trochus pictus*, Wood; *Monodonta turrita*, Menke; *Thalotia dubia*, Ten. Woods.

114. Thalotia chlorostoma, Menke *(Trochus)*. Moll. Nov. Holl., 1843, p. 17, No. 68.

115. Thalotia neglecta, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part i., p. 194, pl. i., f. 6.

116. Thalotia blandiana, Crosse *(Trochus)*. Journ. de Conch. 1864, p. 339, pl. xiii., f. 1.

117. Thalotia abnormis, Crosse. Journ. de Conch., 1864, p. 341, pl. xiii., f. 2.

118. Thalotia freycineti, Fischer *(Trochus)*. Journ. de Conch., 1878, p. 64.

119. Phasianotrochus carinatus, Perry *(Bulimus)*. Conch., 1811, pl. xxx., f. 1; *B. eximius*, Perry; *Monodonta rosea lineata*, Lamarck; *Trochus badius*, Wood; *T. australis*, Quoy & Gaimard; *T. peronii quoyi*, Philippi; *T. lividus vermiculosus fulmineus*, Kiener.

120. Phasianotrochus bellulus, Dunker *(Trochus)*. Abbild. Besch. Conch., 1845, vol. ii., part 2, pl. vii., f. 6.

121. Phasianotrochus irisodontes, Quoy & Gaimard *(Trochus)*. Voy. Astrolabe, 1834, vol. iii., p. 246, pl. lxiii., f. 7-12. *Monodonta virgata*, Menke; *T. iriodon*, *T. virgulatus*, *T. minor*, *T. schrayeri*, Philippi.

122. Phasianotrochus nitidulus, Philippi *(Trochus)*. Zeit. fur Malak, 1849, p. 171.

123. Phasianotrochus apicinus, Menke *(Monodonta)*. Moll. Nov. Holl., 1843, p. 15, No. 58.

124. Bankivia fasciata, Menke *(Phasianella)*. Syn. Meth. Moll., 1830, pp. 51, 141. *P. fulminata*, *P. undatella*, Menke; *B. varians*, Krauss; *B. purpurascens*, *B. major nitida*, A. Adams.

125. Leiopyrga picturata, H. and A. Adams. Ann. Mag. Nat. Hist., 3rd Series, 1863, vol. xi., p. 19.

126. Leiopyrga octona, Tate. Trans. Roy. Soc. S. Austr., 1891, vol. xiv., part 2, p. 260, 261, pl. xi., f. 5.

127. Gibbula tiberiana, Crosse *(Trochus)*. Journ. de Conch., 1863, p. 381, pl. xiii., f. 2. *Cantharidus decoratus*, Adams & Angas; *Gibbula aurea*, Ten. Woods; *Thalotia tesselata*, Ten. Woods; *G. smaltata*, Fischer.

128. Gibbula reedi, Verco. Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., p. 307, pl. xxix., f. 5.

129. Gibbula coxi, Angas. Proc. Zool. Soc. Lond., 1867, p. 115, pl. xiii., f. 26.

130. Gibbula lehmanni, Menke *(Turbo)*. Moll. Nov. Holl. 1843, p. 13, No. 48.

131. Gibbula tasmanica, Petterd. Quarterly Journ. of Conch., Leeds, 1877, vol. ii., p. 103.

132. Minolia preissiana, Philippi *(Trochus)*. Zeits. fur Malak., 1848, p. 123. *Gibbula porcellana*, A. Adams; *G. weldii*, Ten. Woods.

133. Minolia vitiliginea, Menke *(Trochus)*. Moll. Nov. Holl., 1843, p. 18, No. 73. *Margarita tasmanica*, Ten. Woods.

134. Minolia philippensis, *Watson (Trochus [Solariella])*. Journ. Lin. Soc. Lond., 1881, vol. xv., p. 92.

135. Calliostoma meyeri, Philippi *(Trochus)*. Zeits fur Malak, 1848, p. 101. *T. levis*, Hombron and J; *Zizyphinus armillatus*, Reeve; *Z. euglyptus*, Adams.

136. Calliostoma nobile, Philippi *(Trochus)*. Conch. Cab., 1846, Bd. ii., Abt. ii., iii., p. 86, pl. xv., f. 6, and pl. xxxviii., f. 1; *T. rubiginosus*, Valenciennes; *Z. splendidus*, Philippi.

137. Calliostoma australis, Broderip *(Trochus)*. Zool. Journ., 1830, vol. v., p. 331, tab. suppl. 49, f. 3.

138. Calliostoma ciliare, Menke *(Trochus)*. Moll. Nov. Holl., 1843, p. 17, No. 66.

139. Calliostoma rubropunctatum, A. Adams *(Zizyphinus)*. Proc. Zool. Soc. Lond., 1851, p. 167. *C. spinulosum*, Tate.

140. Calliostoma hedleyi, Pritchard & Gatliff. Proc. Roy. Soc. Vict., 1902, vol. xiv. (n.s.), part 2, p. 182, pl. ix., f. 4.

141. Calliostoma legrandi, Ten. Woods *(Zizyphinus)*. Proc. Roy. Soc. Tasm., 1876 for 1875, p. 154.

142. Calliostoma poupineli, Montrouzier, *(Trochus [Zizyphinus])*. Journ. de Conch., 1875, p. 40, pl. iv., f. 6. *Z. comptus*, A. Adams; *C. purpureo-cinctum*, Hedley.

143. Calliostoma allporti, Ten. Woods *(Trochus [Zizyphinus])*. Proc. Roy. Soc. Tasm., 1876 for 1875, p. 155.

144. Calliostoma zietzi, Verco. Trans. Roy. Soc. S. Austr., 1905, vol. xxix., p. 166, pl. xxxi., f. 1, 2, 3.

145. Calliostoma incertum, Reeve *(Zizyphinus)*. Conch. Icon., 1863, vol. xiv., pl. v., f. 28.

146. Astele subcarinatum, Swainson. Proc. Roy. Soc. Van Diemen's Land, 1854, vol. iii., p. 36, pl. vi., f. 1-2. *Eutrochus perspectivus*, A. Adams; *Calliostoma adamsi*, Pilsbry; *Zizyphinus subgranularis*, Dunker.

147. Astele multigranum, Dunker *(Zizyphinus)*. Mal. Blätt, 1871, vol. xviii., p. 169.

148. Astele calliston, Verco. Trans. Roy Soc. S. Austr., 1905, vol. xxix., p. 167, pl. xxxi., f. 7, 8.

149. Minos petterdi, Crosse *(Fossarina)*. Journ. de Conch., 1870, p. 303, 1871, pl. xii., f. 1. *Fossarina simsoni*, Ten. Woods.

150. Euchelus baccatus, Menke *(Monodonta)*. Moll. Nov. Holl., 1843, p. 14, No. 51. *Trochus aspersus*, Koch.

151. Euchelus scabriusculus, Angas. Proc. Zool. Soc., Lond., 1867, p. 215, No. 181. *E. tasmanicus*, Ten. Woods.

152. *Euchelus vixumbilicatus*, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part 1, p. 196, pl. i., f. 4.

153. Euchelus fenestratus, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part 1, p. 195, pl. 1, f. 2.

154. Euchelus pumilio, Tate. Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part 1, p. 196, pl. i., f. 3.

155. Euchelus ampullus, Tate, Trans. Roy. Soc. S. Austr., 1893, vol. xvii., part 1, p. 197, pl. i., f. 5.

156. Basilissa radialis, Tate *(Seguenzia)*. Trans. Roy. Soc. S. Austr., 1890, vol. xiii., p. 192, pl. ix., f. 6; var. *bilix*, Hedley *(Astele)*, Records Austr. Mus., 1905, vol. vi., part 2, p. 48, f. 13.

Family UMBONIIDÆ.

157. Teinostoma cancellata, Tate *(Ethalia?)*. Trans. Roy. Soc. S. Austr., 1878-9, p. 139, pl. v., f. 11 *a* to *c*.

158. Teinostoma lucida, Adams & Angas *(Neritula)*. Proc. Zool. Soc. Lond., 1863, p. 35.

159. Adeorbis vincentiana, Angas. Proc. Zool. Soc. Lond., 1880, p. 417, pl. xl., f. 9.

160. Adeorbis kimberi, Verco. Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., p. 308, pl. xxix., f. 1 and 2.

Family NERITIDÆ.

161. Nerita melanotragus, E. A. Smith. "Alert" collection, Zool., 1884, p. 69, No. 82. *N. nigra*, Gray (non Chemn.); *N. atrata*, Reeve (non Chemn.); *N. saturata*, Hutton.

MICROSCOPICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1906-7.

OFFICERS.—Chairman, Mr. W. Fuller; Vice-Chairman, Mr. W. B. Poole; Committee, Messrs. D. Gordon and D. Mawson, B.E., B.Sc.; Minute Secretary, Mr. H. A. Whitehill; Hon. Secretary, Mr. E. J. Bradley, Dover Street, Malvern; Auditors, Messrs. S. Smeaton, B.A., and T. Godlee.

In submitting the report for the year 1906-7 the Committee is pleased to state that the Section has entered the new quarters provided for the Royal Society and its Sections. During the past session the average attendance of members at meetings and excursions has been maintained to the standard of previous sessions, whilst the roll of members shows that steady progress is being made, despite the fact of the usual loss through death and resignations. The Committee deplores the death of Mr. David Fleming, a foundation member and past Chairman, who was holding office as Vice-Chairman at the time of his demise, and also the death of Miss Heyneman, a foundation member.

The position of the Section generally is now more favourable to progress than at any time in its previous history, and a more active interest is manifested by members, who, on the whole, are displaying a greater tendency to take up special lines of original research.

The constitution of the Section has been slightly remodelled, and the regulations regarding the number of officers and admission of honorary corresponding members have been [illegible]ded.

The following meetings and excursions have been held during the session:—

September 23, 1906.—Annual general meeting, at which an address was delivered by the Chairman, Mr. W. Fuller, on "The Miscroscope in Science and Commerce."

October 23.—Paper on "The Construction, Stocking, and Maintenance of the Fresh-water Aquarium," by Mr. S. Smeaton, B.A.

November 27.—Mr. G. Quinn read a paper on "Some Parasitic Fungi found in our Gardens, and Methods of Prevention," illustrated by diagrams and specimens.

March 23, 1907.—Dredging excursion, Port River.

March 26.—Exhibition of work done by members during the summer recess.

April 20.—Excursion to Patawalonga River, *via* Fulham.

April 23.—Paper by Mr. W. B. Poole on "Diatoms," with diagrams and various specimens of many species, etc.

May 28.—Exhibition of specimens of microphotography by Mr. W. B. Poole, Hydrozoa by Mr. Bradley, and Rotifera by Mr. Showell.

June 12.—Conversazione in connection with the opening of the new rooms.

June 25.—Exhibition and descriptive account by Dr. E. Angas Johnson of a number of Bacteria and Parasites affecting man and beasts, and also exhibition of cancer of mouse obtained by artificial inoculation.

July 23.—Conversation meeting and exhibition of Microphotographs by Mr. Dollman.

August 24.—Excursion to Blackwood.

August 27.—Paper on "Desmids" by Mr. E. J. Bradley, illustrated by blackboard sketches and living specimens.

September 24.—Excursion to Happy Valley.

EDGAR J. BRADLEY, Hon. Secretary.

MICROSCOPICAL SECTION
OF THE
ROYAL SOCIETY OF SOUTH AUSTRALIA.

BALANCE-SHEET, SESSION 1906-7.

Receipts.

	£	s.	d.
Subscriptions, 1906-7	8	17	6
Balance in hand beginning of Session ...	1	3	8
Grant from Royal Society	9	0	0
	£19	1	2

Expenditure.

	£	s.	d.
Subscriptions, 1906-7, paid to Treasurer of Royal Society	8	17	6
Postage and Duty Stamps	2	0	8
Stationery and Printing	2	14	0
Attendance	1	10	0
Balance in hand	3	19	0
	£19	1	2

EDGAR J. BRADLEY, Hon. Secretary.

Audited and found correct.

S. SMEATON,
THEO. GODLEE, } Auditors

September 17, 1907.

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An Experimental Investigation of the Nature of the γ Rays.—No. 1.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and J. P. V. Madsen, D.Sc., Lecturer on Electrical Engineering.

[Received January 2, 1908; read May 5, 1908.]

In papers recently published in the "Proceedings of the Royal Society of South Australia" (May and June, 1907) and in the "Philosophical Magazine" (October, 1907) an attempt was made to show that the ether-pulse theory of γ and X-rays might prove to be incorrect after all, and that most of the known properties of these rays could be explained more simply and directly on the supposition that they were material and consisted of neutral pairs. The arguments were based on comparison of known phenomena with deductions from each of the two opposing hypotheses. At that time there did not seem to be any opportunity of appeal to a decisive experiment.

The object of this paper is to give a preliminary account of an investigation which appears to us to give a final answer as regards the γ rays, and to show that they are material in nature.

Secondary radiation, which is excited in an atom by a passing wave or pulse, must be distributed symmetrically with regard to a plane passing through the atom perpendicular to the direction of motion of the pulse. If we speak of the primary pulse as going forwards, the secondary radiation is just as likely to go backwards as forwards. This is a well-recognized principle. For example, J. J. Thomson divides the secondary radiation, due to γ rays, into two equal parts, which he supposes to move away symmetrically in opposite directions, and, for convenience of calculation, parallel to the direction of the primary rays (Cond. of Electricity through Gases, p. 406). Supposing, therefore, a pencil of γ rays to pass normally through a plate so thin that its absorption may be neglected, the secondary radiation should be exactly the same on the two sides of the plate—in amount, in quality, and in distribution; and it ought not to be possible to discover, by any comparison of the secondary radiations on the two sides, which is the face of entry and which of emergence.

Consider now the ionization-chamber represented in fig. 1. The two ends are closed by plates, of which A and A' are alike; so also are B and B'. The substance of A and A' is different to that of B and B'. The nature of the side walls is immaterial. A pencil of γ rays passes along the axis of the chamber, which is represented by a dotted line. The ionization current within the chamber is measured as usual by inserting a high potential electrode connected to an electroscope.

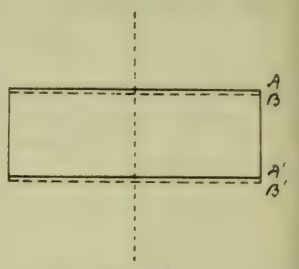


Fig. 1.

When the plates A and B are inverted, there is a change in the amount of the current; so also when A' and B' are inverted. By an extension of the principle already stated, it ought not to be possible, on the ether-pulse theory, to discover which way the rays are going, up or down in the figure, by comparing the consequence of inverting A and B with that of inverting A' and B'.

As a matter of fact, the direction can be discovered with ease: the more easily the greater the difference between the atomic weights of A and B.

For example, in one experiment of ours the chamber was of cylindrical form, 3 inches high and 10 inches diameter. The plates used were of aluminium and lead. The thickness of each plate was a little less than 2 mm. Inversion of the top plates A and B made a difference in favour of Al of less than 1 per cent., *i.e.*, the current was slightly larger when Al was next the chamber. On the other hand, inversion of the bottom plates made a difference of 44 per cent. in favour of Pb, *i.e.*, the current was 44 per cent. larger when the Pb was on top. The details are shown in the figure. Allowance was made for all radiation other than that which proceeded down the conical opening in the lead block.

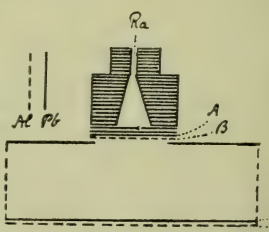
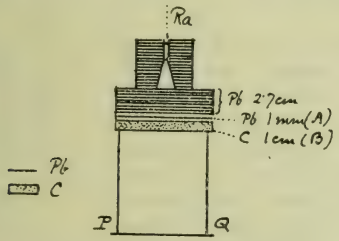


Fig. 2.

It may be well to point out that this effect cannot be ascribed to any complication due to secondary or tertiary rays. No doubt the radiation in the chamber is very complex; but the fact is immaterial. Provided that the chamber is symmetrical in the first place, then the secondaries

must be symmetrical also if the ether-pulse theory is correct, and therefore the tertiaries and so on. Nor is it necessary to consider whether the secondary radiations are β rays or scattered γ rays. Also, it must be remembered that the secondary radiations which enter the chamber have their origin almost entirely in a very few millimetres of material bordering on the chamber. Therefore, the γ rays are in almost exactly the same condition, both as to quality and as to quantity, when they excite secondary radiations from the top plate as they enter the chamber, and secondary radiations from the bottom plate as they leave.

The details of the experiment may be varied greatly: but in all the cases we have tried the want of symmetry is obvious. In fig. 3 are shown the details of one other case, in which carbon and lead were the materials used, and the form of the



(1) Current with plates arranged as above = 59·8
(2) " " A and B inverted ..... = 54·4
(3) As in (1), but base PQ changed to carbon = 50·5

Fig. 3.

chamber was different. It seems unnecessary to give more, because, in the first place, the experiments are easy to repeat; and in the second place, the complete quantitative analysis of the figures depends on several factors, the influence of which is imperfectly understood, such as the previous screening of the rays, the form of the chamber, and the respective parts played by the original γ rays, cathode rays, and secondary γ rays, if any such exist. The experiments, as they stand, show how far away is that symmetry which the ether-pulse theory demands. It seems to us that there is no escape from the conclusion that the γ rays are not ether pulses.

Let us, therefore, proceed to consider the hypothesis that the γ rays are material. In the paper already mentioned, it was argued that they might well consist of neutral pairs, liable to be broken up on encountering atoms or parts of

atoms; and that the secondary cathode radiations might be the negative particles thus set free. Let us suppose, provisionally, that the particles, when set free, move at first in the direction of the γ stream, but are subsequently scattered in the usual manner of β rays. [It is here that the absence of symmetry arises. On the pulse theory the particles should go equally backwards and forwards; indeed, if they were ejected by atomic explosions. the result of energy accumulated from passing pulses, as suggested by J. J. Thomson in the case of X-rays, they would move equally in all directions.]

Wigger gives a table (Jahrbuch der Radioaktivität, Bd. ii., p. 431) showing that the γ rays are absorbed according to a density law pretty strictly, except for small thicknesses of substances of large atomic weight.

Assume this law to hold good, and also assume for the present that the absorption of β rays follows the density law. The latter is only roughly true, of course; but we may deal with quantities in a broad fashion first, and make the proper amendments afterwards.

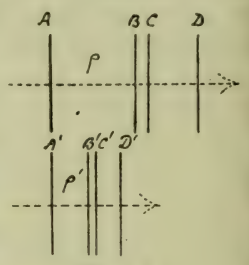


Fig. 4.

We can now compare the quantities of cathode radiation which should emerge from the far sides of two plates of different densities ρ and ρ'. Let these be represented by AD and $A'D'$ in the figure, and let BC and $B'C'$ be corresponding strata of equal weight: in fact, let $AB/A'B' = BC/B'C' = CD/C'D' = \rho'/\rho$. Let the plates be crossed by equal pencils of γ rays, as shown in the figure. A certain quantity of γ radiation is absorbed in crossing BC. In the language of our present hypothesis we should say that a certain number of γ particles are stripped of their positives, and the negative remainders go on. An equal number of negatives are set free in $B'C'$ because the two strata are of equal weight. Of those set free in BC only a certain number emerge from the face D, because of the absorption of the plate CD. Since CD and $C'D'$ are of equal weight, a similar absorption occurs in the case of the particles set free in $B'C'$. Thus the same number emerge from each plate. Integrating for all effective strata, the whole cathode radiations emerging from the two plates are equal.

We thus find that if the absorption of β and γ rays both followed the density law, the secondary cathode radiation on the far side of a plate—we may call it the "emergence" radia-

tion—would be the same for all materials. There should be no such relation between the amount of the radiation and the atomic weight of the plate, as various observers have shown to be true for the secondary cathode radiation of "incidence," a relation which is closely parallel to that found in the case of β rays.

Experiment is in agreement with this theory, for it shows that no such relation exists in respect to the emergence radiations: in marked contrast to what happens in the case of the radiations from the front sides of plates of various materials, the incidence radiations.

It is true that the emergence radiations are not all equal, but this is to be expected, because (1) the amount of secondary cathode radiation depends, as Kleeman has shown, on the previous screening of the γ rays; (2) the β rays are not absorbed strictly according to a density law; (3) the γ rays also depart from this law. We have made no serious attempt as yet to disentangle the effects of these various disturbing factors. In fact, the task promises to be long and intricate, for it will be necessary to find out how much of the ionization in the chamber is due to each class of rays; to discover the law of distribution of the radiations in space, so that the form of the chamber may be allowed for, if necessary; to find out the nature of the departures from the density law of those β and γ rays which are in question; and so on. Nevertheless, the results are satisfactory, so far as we have gone. The amount of emergence radiation is found to depend on the previous screening of the rays. In one case the inversion of a C, Pb pair of plates from C, Pb to Pb, C, altered the current in the ratio 1 : 1·11 when the rays had been previously screened by Pb; but in the ratio 1 : ·96 when the screen was changed to C. Again, when the rays had previously passed through an iron screen, the inversion Pb Fe to Fe Pb changed the current in the proportion 1 : 1·12, but when a lead screen was substituted for an iron one the change was 1 : 1·04. In illustration of the effect of the second disturbing factor mentioned above, we have found that, other things being equal, the substances of small atomic weight give the most secondary radiation, in a general way; and it may be no coincidence that in some cases we have found Sn and Fe to give surprisingly small amounts. This is in agreement with what is to be expected, for it is clear, on consideration of the argument already given, that the greater the β ray absorption of a substance in proportion to its density, the less "emergence" radiation should issue from it. Some observers have found Sn and Fe to possess exceptional absorbing powers. We do not wish, however, to lay any stress upon these

last observations, some of which we may not have interpreted correctly; but we mention them in order to show that the inequalities that are found to exist between the emergence radiations of various substances promise to be reducible to order as soon as the difficulties of interpretation have been surmounted.

Let us now consider the cathode radiations on the front sides of the plates. Of the cathode particles set free in BC and moving at first in the direction of the γ rays, a certain proportion, say p, is returned by what is beyond. These move towards the face A, and a certain number of them succeed in reaching it and emerging therefrom. In the case of the other plate the proportion returned is p'. The absorption in $B'A'$ is the same as in BA, because the weights are the same. Comparing the two plates, stratum by stratum, we find that the "incidence" radiation of one plate is to the incidence radiation of the other plate as p to p'. Now p and p' are the well-known constants of the β rays.

When a stream of γ rays is allowed to fall upon a plate the cathode radiation which issues from the place of incidence must be divisible into two parts. One consists of scattered β particles derived from the stream of such particles which was travelling with the γ rays before incidence, and which was formed during the previous transit of the screens employed, solid, liquid, or gaseous. This part is scattered to an extent which depends on the atomic weight of the plate, according to the usual law of β particles. The other part is originated in the plate itself in the manner just described, and the amount of it is also regulated according to the β ray law. When, therefore, observers have measured the secondary radiation, due to γ rays, and have found a law corresponding to that for β rays, the reason of the correspondence has been that they really were measuring the secondary radiation due to β rays. Properly speaking, the secondary radiation, produced by γ rays, or, rather, *from* γ rays, is proportional to the density of the substance traversed (*cf.* Wigger's table), and this is only another form of the law of absorption of γ rays.

The relative importance of the two parts of the incidence radiation just mentioned must depend on the circumstances of the experiment.[1] The researches of Kleeman (Phil. Mag., Nov., 1907) show very well how the second part, which is influenced by previous screening, modifies the effect of the

[1] In a recent letter addressed by one of us to "Nature," too great a preponderance was assigned to the first part under all circumstances.

first part, which is not so influenced, but which follows the law of β rays strictly.

It is easy to show, by comparing corresponding strata at the front and back of one plate, that the incidence radiation should be somewhat less than p times the transmitted radiation. Somewhat less, because the cathode radiation, which is turned back, is scattered and softened in the process.

To sum up:—On the ether-pulse theory we ought to find perfect symmetry in the secondary radiations from the two sides of a plate. But experiment shows nothing of the kind.

On the material or neutral-pair theory, the "incidence" radiations should follow the β ray law. This is known to be the case. The emergence radiations should not follow the β ray law, and experiment shows that they do not. If the density law held for both β and γ rays, and if the γ rays were homogeneous, the emergence radiations should all be equal. As already explained, experiment shows that the observed inequalities give promise of ready explanation, on the ground that no one of these suppositions is quite true.

It is, perhaps, better not to extend the preliminary account of these experiments by any lengthy discussion of the issues arising from them. Many points that invite consideration have been discussed already in the papers first referred to. Moreover our own further experiments are incomplete, and their full interpretation is not yet certain. We will, therefore, confine ourselves to one or two questions which seem of special interest. The X-rays resemble the γ rays so closely that it is practically inconceivable that the two radiations should be essentially different. The secondary cathode radiations, which are set free when X-rays impinge on any material, must therefore have been part of the X-ray stream, and must start their independent existence by moving on in the line of the X-ray motion. Their velocity is much smaller than that of the secondary cathode rays due to γ rays, and they are much more readily scattered. It may still remain an open question whether or no the X-ray stream contains ether pulses. Perhaps their existence must be supposed in order to explain the velocity experiment of Marx, and the diffraction experiment of Haga and Windt. Possibly they are also required in order to explain Barkla's polarization experiments: but we do not think that the experiment described by Barkla in "Nature" (October 31, 1907) is in any way decisive.

It seems proper to consider a possibility that the negative particle, when it moves on in the original line of motion of the pair from which it came, retains also its original velocity. It is a striking fact that the cathode particle, due to the γ rays, has the same speed, very nearly, as the β particle

issuing from the original radioactive material. And it looks quite unlike a coincidence that similar comparisons can be made in the case of the X-rays. The secondary cathode radiations due to these rays have velocities which, at the least, are of the same order as the velocities of the cathode particles in the X-ray bulb. If we examine the table given by Innes (Proc. Roy. Soc., Aug. 2, 1907, p. 461), and if we may be allowed to adopt an interpretation differing somewhat from the author's, but more natural, it seems to us, in view of the conclusions of this paper, we find that the velocities of the electrons emitted by all the metals are practically the same, zinc being an exception, because it is unable to break up the hardest rays. We find that the velocities range from about 6×10^9 to $7{\cdot}5 \times 10^9$ for soft rays, and 6×10^9 to 8×10^9 for hard rays. Remembering that bundles of X-rays are very heterogeneous, the natural conclusion seems to be that the softest rays give the slowest speeds, and that the velocity of the secondary rays increases with the hardness of the X-rays from which they are derived.[2] Now the hardness of the rays grows with the speed of the cathode particles in the bulb. Is it then possible that the cathode particle is first set in motion by the electromotive force in the bulb, strikes the anticathode, and picks up a positive there, becomes neutral, and is now called an X-ray, is subsequently stripped of the positive, and becomes a secondary cathode particle, the identity of the negative remaining the same throughout, and its speed invariable, or nearly so? The difficulty comes in when we try to consider the part played by the mass of the positive. Probably it becomes necessary to consider it as small compared to the mass of the negative. In many ways such a supposition would fit in very well. We should then understand why the positive is so hard to isolate: also a radioactive atom, in ejecting a γ particle would not lose appreciably in weight. Lilienfeld believes he has found the positive electron to be less massive than the negative. (Deutsch. Phys. Gesell. Verh., 9, 7, April 15, 1907.)

And, again, may not the β and γ forms be interchangeable at times? A γ particle, which had been stripped of its positive, and become a secondary cathode, or β ray, would be lost to measurement as a γ ray; and we should thus have an explanation of how the γ rays are "absorbed," and why the absorption follows an exponential law. And in the same way, if a β particle picked up a positive, it would disappear from view as a β particle, it would be "absorbed."

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[2] By independent experiment, Bestelmeyer (Ann. d. Phys., xxii., p. 429, 1907) and Cooksey (Amer. Jour. of Science, Oct., 1907) arrive at the same conclusion.

Although we have made a few experiments with magnetic fields, we have not yet come to any conclusions as to whether or no there are γ pairs which have become loosened in the attachment of positive to negative, forming a softer and more ionizing radiation. Their existence might be suspected since there is an analogous effect in the case of X-rays; and probably they would be found more at the back of the penetrated plate than in front of it.

A few further experimental illustrations are shown diagrammatically in Figs. 5-7, with the explanations attached.

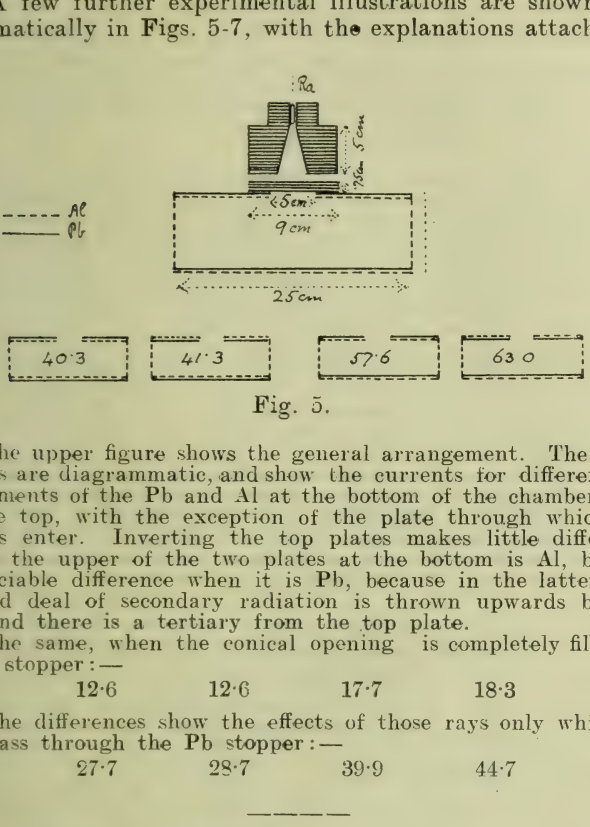

Fig. 5.

The upper figure shows the general arrangement. The lower figures are diagrammatic, and show the currents for different arrangements of the Pb and Al at the bottom of the chamber, and at the top, with the exception of the plate through which the γ rays enter. Inverting the top plates makes little difference where the upper of the two plates at the bottom is Al, but an appreciable difference when it is Pb, because in the latter case a good deal of secondary radiation is thrown upwards by the Pb, and there is a tertiary from the top plate.

The same, when the conical opening is completely filled by a Pb stopper:—

12·6 12·6 17·7 18·3

The differences show the effects of those rays only which do not pass through the Pb stopper:—

27·7 28·7 39·9 44·7

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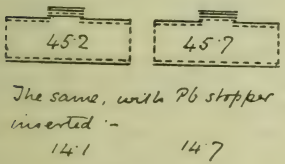

Fig. 6.

These show the effect of inverting that portion only of the top plate where the γ rays enter. Three Pb plates = ·55 cm., Al plate = ·16 cm.

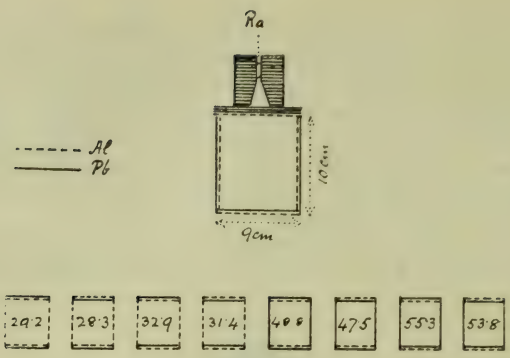

Fig. 7.

The upper figure shows the general arrangement. The wall of the cylindrical vessel was of brass; a Pb or an Al lining could be inserted as shown. The lower figures are diagrammatic, and show the currents for different arrangements of Pb and Al at top, bottom, and sides. Inversion of the plates, *through* which the γ rays pass into the chamber, makes little difference; but there is a great alteration if the material is changed on which the γ rays fall, or the emergence radiation from the top plate. The base is of less importance than in fig. 5; but the sides of more importance. This should clearly be so, for geometrical reasons.

When the conical opening was filled by a Pb stopper, the currents were all reduced considerably, but retained the same proportions pretty nearly.

On the other hand, when a small pencil of β rays was admitted through a hole in the centre of the top plate, a change of the material of the bottom became more effective, and of the sides less effective than before; but this difference became smaller when thin Al sheets were so placed as to scatter the β rays on their entry into the chamber.

In conclusion, we should like to add that Wigger was the first, so far as we know, to show clearly that the secondary radiation of Al, on the far side of the plate, might be greater than that of Pb. A comparison of the emergence radiations of different metals was made by Dawes (Phys. Rev., xx., p. 182), who showed that they did not follow the law of the incidence radiations. The same effect was indicated in the experiments of Eve (Phil. Mag., Dec., 1904). We have little doubt that the interesting experiment of Mackenzie (Phil. Mag., July, 1907) is to be explained on the lines indicated in this paper. In fact, it is clear that this is the case in a broad sense; but it is difficult to give a complete explanation until the laws are so completely worked out that they can be applied to the interpretation of experiments, which are really very complicated, although at first sight they may seem to be simple.

DESCRIPTION OF A NEW SPECIES OF ORCHID.

By R. S. ROGERS, M.A., M.D.

[Read November 5, 1907.]

Prasophyllum occidentale, sp. nov.

Plant.—A somewhat dwarfed species, varying from 5 to 8 in. in height: the fistula in the sheath placed high up, sometimes immediately below the spike. Leaf-lamina greatly exceeding the spike, extending in my smallest specimen $4\frac{3}{4}$ in. beyond the fistula, and in my tallest 6 in. beyond this point. The spike not crowded, consisting of from ten to fourteen green flowers.

Flowers.—Lateral sepals about 3 lines long, slightly bidentate, united except in their distal fourth. Dorsal sepal somewhat shorter ($2\frac{1}{2}$ lines), erect, acuminate, concave. Lateral petals narrow-lanceolate, very slightly shorter than dorsal sepal.

Labellum.—Sessile, about 2 lines long, reflexed about the middle, tip acuminate: membranous portion fairly wide and slightly crenulated, callous part continues a short distance beyond the bend: does not protrude between the free tips of sepals.

Column.—Middle lobe quadrangular. Lateral appendages about same height as rostellum; unequally lobed, the smaller one being given off about middle of appendage. Stigmatic plate speckled in my specimens.

I found this orchid growing close to the shore at Streaky Bay on September 26, 1907. Only four specimens were collected, and three of these were seeding, so that it should be looked for at the beginning of the month.

It bears a superficial resemblance to the Western Australian form, *P. macrostachyum*, from which, however, it may be distinguished by its relatively long and narrow petals, by the extent to which its lateral sepals cohere, and by the great length of its leaf-lamina.

There is no recorded member of the genus in this State with which it is likely to be confused, unless it be *P. fuscum*. In this species the lateral sepals are free, whereas in the new form they are connate, a feature which at once makes the diagnosis easy.

The Ionization Remaining in Gases after Removal from the Influence of the Ionizing Agent.

By J. P. V. Madsen, D.Sc., B.E.

[Read April 7, 1908.]

Introduction.

In a paper by Professor Bragg and Mr. Kleeman,[1] a theory of initial recombination was advanced to explain the cause of the lack of saturation in gases exposed to the action of the α particles of radium. The effect was found to be due to the immediate action between a parent molecule and the electron which was ejected from it as a result of the ionizing influence of the α particle. It was shown that it was easy to reconcile with this theory the result of an experiment described by Professor Rutherford,[2] which suggested that it is easier to obtain the saturation current in a gas when the gas is quickly removed from the influence of the ionizing agent before testing. Rutherford's experiment would, of course, indicate that the process of initial recombination would be completed in a very short time after a molecule had been ionized. However, as explained in a later paper by Professor Bragg,[3] it was not essential to the theory of initial recombination that the process should be completed within any set time, in which case many important considerations would result.

The author undertook the repetition of Rutherford's experiment, and the non-success of some preliminary attempts led to the further suggestion that for a certain length of time it was conceivable that the positive and negative ions might remain in a state of incomplete combination, their final recombination being precipitated by some change of conditions. The existence of such partially combined pairs of ions would help to explain much of the mechanism of phosphorescence, and would appear to have some connection with the clusters described by J. B. B. Burke,[4] which were the product of ionization, and gave rise under some conditions to phosphorescent glow, contained energy, and yet were not electrified.

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(1) Trans. Roy. Soc., S.A., vol. xxix., 1905.
(2) Phil. Mag., vol. 47, p. 158.
(3) Phil. Mag., May, 1906.
(4) Phil. Mag., vol. i., p. 342, 1901.

Again, in some experiments described by C. D. Child [5] upon the arc through mercury vapour, clusters very similar in nature to those described by Burke are met with, and their behaviour was only explained on the hypothesis that recombinations between positive and negative ions were not always complete or stable, and that the clusters so formed were, under suitable conditions, readily broken up, giving rise to ionization.

It may not be out of place at this point to remark that the nucleus of such clusters might possibly be formed either by the partial recombination of a positive and a negative ion which have each had time to become attached to neutral molecules of the gas or by the immediate partial recombination of a parent molecule and the electron ejected from it by the process of ionization.

Just as this paper was near completion the results of an investigation by Von Erich Barkow [6] came to hand, in which the existence of neutral pairs of ions, evidently produced in the former manner, offers a ready explanation of the effects observed.

It was, however, more with the idea of finding out whether a cluster is formed in the latter way that the work of this present paper was carried out. When two oppositely charged ions, approaching each other, are at a distance apart "r" (in the present case "r" is of the order of the molecular free path), the particles will revolve in closed orbits around each other, if the kinetic energy due to their relative motion is less than $\frac{e^2}{r}$ (e being the charge on an ion). An electrical field will tend to disturb this motion, and it is one of the purposes of the present paper to decide whether some such state of semi-combination can persist for an appreciable time, and a separation of the ion be eventually effected by an electrical field, or by a field conjointly with other causes.

Returning to the experiment described by Rutherford, little detail information is given in regard to the apparatus used. It is stated that instead of measuring the current with the uranium oxide covering one electrode, the air which had passed over the uranium was forced between two concentric cylinders between which the electromotive force was acting. It seemed probable that the apparatus described by him earlier in the same paper (p. 144) had been used, in which air, after passing through cotton wool and over the uranium surface, was forced through a wire gauze, and then between

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[5] Phys. Rev., vol. xxii., pp. 221-231, April, 1906.

[6] Annalen der Physik, p. 317, No. 7, 1907.

two cylinders of 2·8 and 1·6 cms. diameter respectively, a potential difference of 32 volts between the cylinders being found sufficient to completely remove all the ions from the gas. The distance of the gauze from the central electrode and the size of gauze used are not definitely stated. It will be

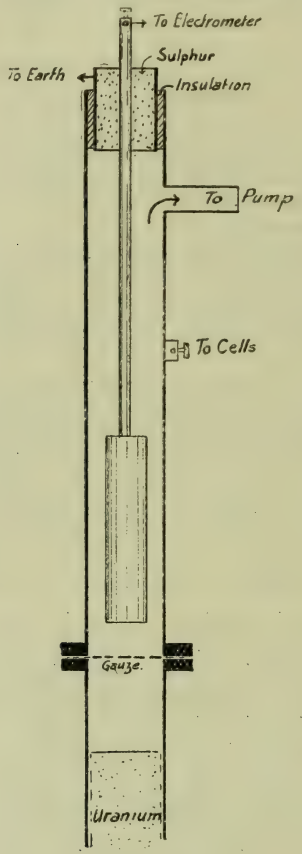

Fig. 1.

shown in the present paper that the form of the saturation curve obtained in such an apparatus depends largely upon these two latter factors, as well as upon the potential difference between the cylinders, and also their size.

In attacking the question of the ionization in gases after their removal from the action of the ionizing agent, two direct

methods suggest themselves. In the first place, ionized gas may, as in Rutherford's experiment, be blown into a chamber in which the ions are to be collected by an electric field. In this case care must be taken to enable the ions to be passed rapidly into a uniform electric field, so as not to subject them at first to a weaker field.

To pass the ionized gas through a fine gauze as Rutherford did would appear the most convenient method to adopt in such a case, although, as will be shown later, it by no means, in all cases, approaches the ideal condition.

In the second method, the ionizing agent may be allowed to act upon the gas which is enclosed in a suitable ionization chamber, and then either the chamber or, what is usually more convenient, the ionizing agent may be removed before the electromotive force is applied between the electrodes.

Both these methods have been used in the present investigation.

Since the shape of the ionization curve obtained in the presence of the ionizing agent is found [7] to depend upon the effects of both general and initial recombination, it is important, no matter which of the above methods is used, in comparing the saturation curves with and without the presence of the ionizing agent, to eliminate the effects of general recombination. Also, diffusion of the ions to conducting surfaces would produce many of the effects which one might expect to be shown by clusters which could be separated by a sufficiently intense field.

§ 1.

The Action of Gauzes.

The first experiments were carried out with an apparatus as shown in fig. 1. Air was used in these experiments, and after passing through a plug of cotton wool was drawn by a water-pump, with suitable pressure regulator, at a speed of 10 cms. per second, over the surface of uranium oxide. Thence it passed through a gauze and between two cylindrical electrodes of 2 cms. and 4 cms. diameter respectively. The outer electrode was connected to a set of small accumulators, the other terminal of the cells being connected to earth. The central electrode was 10 cms. in length, and was supported in a sulphur plug, which in turn was protected by an earthed ring. By suitable keys the central electrode could be connected either to the electrometer or to earth. A Thompson Quadrant Electrometer was used, giving a deflection of 75 scale divisions per volt.

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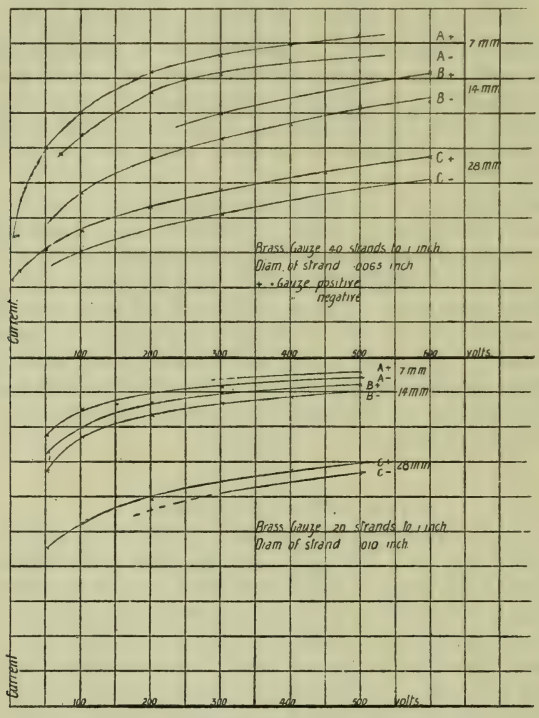
[7] Bragg and Kleeman, Trans. Roy. Soc., S.A., vol. xxix., 1905.

As a similar form of apparatus has been frequently employed where the introduction of a gauze suggested a ready means of localizing the field which was to be used for collecting the ions which were blown along a tube—as, for example, in the experiments of Townsend [8] upon diffusion of ions and [9] in experiments upon the ions which are produced from flames, etc.—it is of some additional interest to know what effects may arise from the introduction of such a gauze. A short account will therefore be given of some preliminary ex-



Figs. 2 and 3.

periments in which the size and nature of the gauze and the distance between the central electrode and the gauze were varied.

The curves, fig. 2, show the results of experiments with a brass gauze having 40 strands to the inch, two sets of wires being interlaced at right angles to each other, each wire

[8] Phil. Trans. Roy. Soc., cxcii., A 1900, pp. 129-158.

[9] Langevin and Block, Comptes Rendus, cxxxix., 1904, p. 792.

being of ·0065 inches diameter. The curves $(A+)$, $(B+)$, $(C+)$, show the relation between the potential difference of the electrodes, and the corresponding electrometer deflections per 0·5 minute for distances of 7, 14, and 28 mm. between the gauze and the flat end of the central cylindrical electrode, the gauze being positive to the central electrode. The curves $(A-)$, $(B-)$, $(C-)$, are corresponding curves obtained when the gauze was negative. Fig. 3 shows similar curves using a brass guaze with 20 strands to the inch, each wire being ·010 in. in diameter.

TABLE A.

Material.	Strands per in.	Diameter of Wires, in.	Deflection for 400 volts. / Deflection for 50 volts.
Brass × ...	20	·010	1·4
Brass × ...	11	·0185	1·25
Brass × ...	14	·015	1·33
Brass × ...	40	·007	1·7
Iron × ...	14	·013	1·25
Iron × ...	21	·016	1·34
Galv. Iron ×	14	·0135	1·26
Copper ‖ ...	16	·013	1·14
Copper ‖ ...	32	·013	1·5

× Represents crossed wire-mesh gauzes.
‖ Represents parallel wire gauzes.

A large number of other gauzes were similarly tested, including some which were built in the form of grids, with one set only of straight wires arranged parallel to each other. As figs. 2 and 3 are, however, typical, the results obtained with some of the other gauzes are given in Table A in terms of the deflections per 0·5 minute at potential differences of 400 and 50 volts respectively between the cylinders with the central electrode in all cases 28 mm. from the gauze. The state of the surface of the gauze was found to have little effect, even when the gauze was wetted, and in the case of iron allowed to rust slightly.

At intervals during each set of experiments the draught was stopped and a reading taken of the amount of ionization which entered the chamber independently of the draught. No special precautions were taken to dry the air, and on one or two occasions the amount of ionization produced by the uranium showed changes which were apparently due to slight dampness of the uranium surface. This accounted for the reduction in the amount of ionization which was observed on such occasions, as the path of the α particles through the gas would be slightly reduced.

It will be observed in both figs. 2 and 3 that there is no very close approach to saturation, although the approach is

much closer in fig. 3 than in fig. 2, even when large potential differences are applied between the electrodes. The results with the gauze positive are in all cases larger than with the gauze negative. Also, the number of ions reaching the central electrode in a given time decreases for any given value of potential difference between the cylinders, as the distance

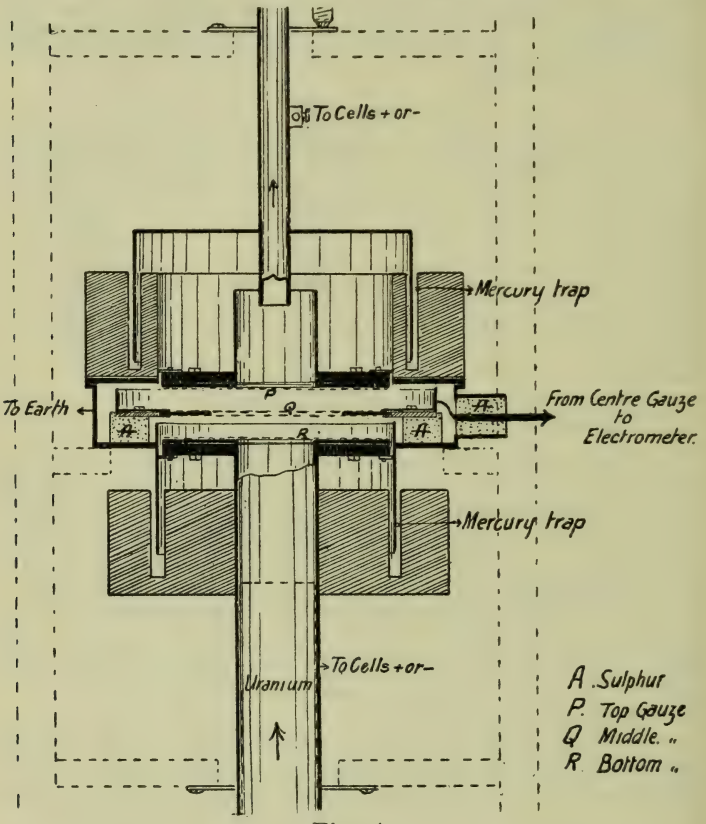


Fig. 4.

between the gauze and the end of the central electrode is increased. When, therefore, even very large potential differences are maintained between the electrodes, the number of ions which reach the central electrode in a given time may give a very false measurement of the number of ions which actually reach the gauze in that time.

It appears from the curves that it is the strength of field in the immediate neighbourhood of the gauze and not so much the actual difference of potential between the inner and outer cylinders that determines the number of ions received by the central electrode. As in the experiments so far described, this field was by no means uniform, it was decided to re-design the apparatus so as to provide for this condition.

An apparatus as shown in fig. 4 was constructed, having three gauzes set parallel to each other with their planes at right angles to the axis of the tube. The central gauze, to which the electrometer was connected, consisted of a brass gauze with 20 strands to the inch, each wire being ·01 in. in

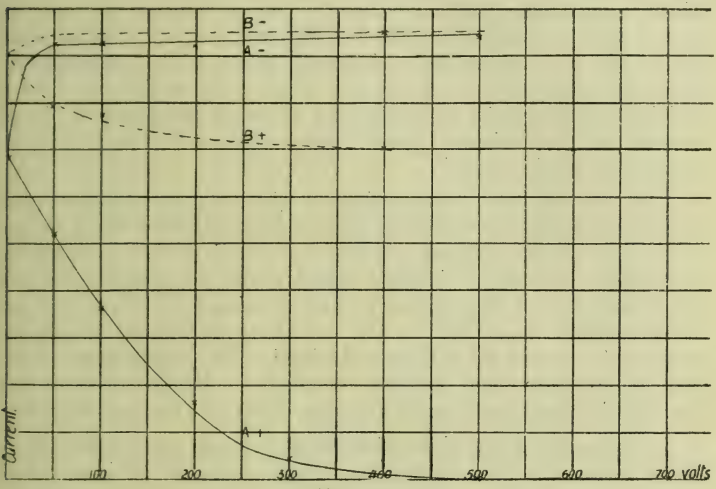


Fig. 5.

diameter, soldered to a thin metal ring and carefully attached to a ring of sulphur in such a way as to allow the air to pass only through the gauze. Earthed metal rings, as shown in the diagram, were found necessary to protect the sulphur from the direct influence of the high-potential plates. On each side of this middle gauze were arranged gauzes which could be easily replaced, and so that their distance from the middle gauze could be varied. In the first set of experiments these gauzes were of brass with 40 strands to the inch, the distance between the top and middle gauzes being 6·5 mm., that between the bottom and middle gauzes 7·5 mm.

In fig. 5, curve $(A -)$, is shown the effect of varying the potential applied to the top gauze, always, however, keeping

it negative, while maintaining the bottom gauze at a negative potential of 41 volts. A draught of 10 cms. per second was maintained as in the earlier experiments. It will be seen from the curve, that with 50 volts applied to the top gauze, a much larger current passes to the middle electrode than when the top gauze is connected to earth; but that further increases in the potential of the top gauze cause very little further increase in the current. Curve $(A+)$, in the same figure, shows how the current varies when the bottom gauze is still maintained at a potential of -41 volts, but with the potential of the top gauze varied through a range of positive values. With the bottom gauze at -41 volts, and the top gauze at $+500$, practically no current passed to the middle electrode—that is to say, a large number of negative ions which would otherwise be drawn to the middle electrode are now completely dragged through it. Similar results occurred when the bottom gauze was maintained at a positive potential of 41 volts, the greatest diminution in the current to the middle gauze being observed when the top gauze was made negative.

To prevent any interaction of the two fields above and below the middle screen, the gauze was replaced by a screen consisting of two gauzes, similar to the first, set parallel to each other and at a distance apart equal to 2 mm. Curves $(B-)$ and $(B+)$, fig. 5, were then obtained by following out the procedure described in the previous test, from which the curves $(A-)$ and $(A+)$ were derived. The same type of result is obtained, but greatly reduced. Single gauzes with finer mesh produced much the same effect as the double gauze.

It appears from these results that when the wider single gauze is used for the central electrode, some of the ions which it should apparently stop are blown completely through it, and more the wider the gauze; but that these are collected by the gauze when the field in the top chamber drives them with sufficient force against the draught. If, then, the top gauze be of the same sign as the bottom gauze, any field in the top chamber greater than about 100 volts per cm. ensures practically all the ions being caught by the middle electrode. In subsequent experiments the top chamber was always so arranged, and the screen of two gauzes was used as the central electrode.

The strength of field in the lower chamber was varied and corresponding currents measured. Curves were obtained for depths of bottom chamber, 7·5 mm., 11·5 mm., and 23·5 mm., respectively. The capacity was determined by an auxiliary condenser in each case, and after correcting the read-

ings for the slight alterations in capacity produced by the change in position of the gauzes, the curves for the different width chambers were found to practically coincide for all except very weak fields.

When, therefore, the bottom gauze is negative, we may conclude that for fields stronger than 50 volts per cm. very few, if any, positive ions penetrate far into the bottom chamber through the lower gauze; otherwise, effects due to recombination in that chamber should have been observed clearly when the depth of the lower chamber was varied. The smaller values of current, obtained when the bottom gauze was negative and the top positive, were due to the action of the field in the top chamber, more particularly its arrangement in the immediate vicinity of the wires of the middle gauze.

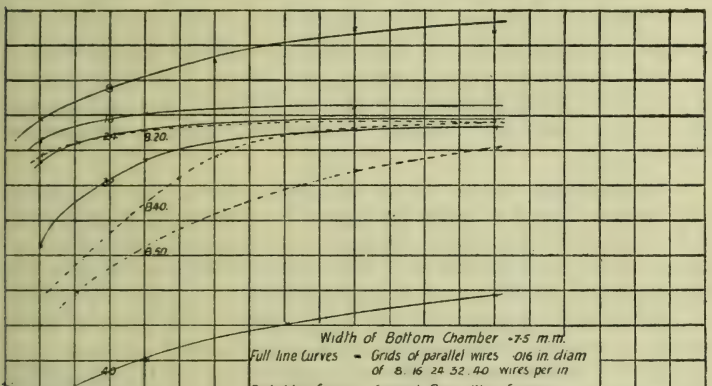


Fig. 6.

In fig. 6 are shown the results obtained with different gauzes for the bottom electrode, and varying fields applied to the lower chamber; the field in the top chamber being maintained, in all experiments, at 100 volts per cm., arranged in such a direction as to prevent the escape of the ions through the middle gauze. The depth of the lower chamber was 11 mm.; the dotted curves are for bottom gauzes of crossed strands of 50, 40, and 20 meshes to the inch respectively. The full line curves are for bottom gauzes made of copper-wire ·016 in. in diameter, set parallel, and equi-

distant from each other, and of 8, 16, 24, 32, and 40 wires to the inch respectively.

The crossed gauzes give results falling very well into line with those from the paralled wire grid, in which the smaller the mesh the harder it was to obtain saturation. It is notable that with all the intermediate gauzes an approach is shown to the same value of maximum current as the field strength is increased. With very fine gauzes very intense fields would seem necessary to drag all the ions through the gauze, while with gauzes much broader than about 16 to the inch ions are apparently readily drawn from distances considerably below the gauze.

All the curves given were obtained from results of experiments in which the bottom gauze was positive. When it is made negative, and the top gauze also negative, very little difference is found in curves for strong fields: with weak fields the values obtained with the gauze positive are as a rule slightly higher than with the gauze negative.

Of numerous gauzes tested, the 20 to the inch crossed brass gauze, with diameter of strand ·01 in., gave the nearest approach to an early saturation, and was used in subsequent experiments.

Rutherford, in his paper already referred to, has shown that gauzes exert a large influence in discharging ions from gas blown through them; he finds that the effect depends, apparently, upon the ratio of the space occupied by the air between the meshes, and the extent of metal in the gauze. As, however, his experiments were performed with a field acting upon one side of the gauze, it seemed necessary to repeat the experiments with no field acting on the gauze, as from the experiments described above it would seem that under this condition the discharging power of the gauze should be even greater than as determined by Rutherford.

The experiment was arranged so that gauzes could be set parallel to and ·5 cm. below the bottom gauze of the chamber used in the previous experiments. A field of 300 volts per cm. was applied to the lower side of the electrometer gauze and 100 volts per cm. above it, thus preventing ions from escaping through the electrometer gauze. Readings of the current were taken with and without the gauze which was to be tested, in position. The ratio of these two readings was taken as a measure of the discharging power of the gauze.

In fig. 7 are plotted the results for parallel grids corresponding to Table B. There appears a certain value of

the ratio—air to metal surface—below which the discharging power rises very rapidly. This effect is similar to that which would result from considering the gauze as a limiting

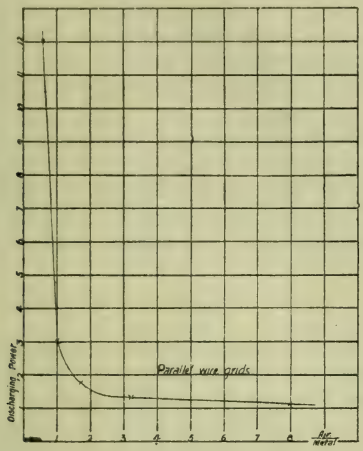


Fig. 7.

TABLE B.

Discharging Powers of Gauzes.

Material.	Strands per inch.	Diam. of Wires, in inches.	Distance between Wires, in inches.	Air. / Metal.	Discharging Power.
Copper ‖	8	·016	·127	8·0	1·1
Copper ‖	16	·016	·050	3·2	1·3
Copper ‖	24	·016	·027	1·7	1·75
Copper ‖	32	·016	·016	1·0	3·0
Copper ‖	40	·016	·010	·6	12·0
Copper ‖	16	·013	·054	3·8	1·25
Copper ‖	32	013	·020	1·4	2·12
Brass ×	11	·0185	·072	1·0	1·35
Brass ×	15	·0155	·051	1·0	1·5
Iron ×	14	·013	·058	1·3	1·5
Iron ×	17	·010	·05	2·6	1·45
Iron ×	17	·013	·046	1·18	1·8
Iron ×	20	·018	·032	·7	2·7
Brass ×	20	·010	·04	1·2	1·65
Brass ×	25	·0095	·03	1·1	2·5
Iron ×	26	·0245	·0245	·6	3·85
Brass ×	40	·007	·018	1·1	5·45
Copper ×	120	·0025	·037	1·2	49·0

× Represents crossed mesh gauzes.
‖ Represents parallel wire grids.

case of a set of parallel tubes of small diameter as used by Townsend in his experiment upon the diffusion of ions.

Comparing these results with those of fig. 6, it is seen that, taking for comparison the brass gauze of 40 meshes per inch, each wire, ·007 in. diameter, and the brass gauze of 20 meshes per inch, each wire ·010 in. diameter; although their discharging powers are as 5·45 to 1·65, nevertheless with a field of 700 volts per cm., applied to their upper surfaces, exactly the same number of ions are drawn through each. Again, twice the number of ions are drawn through the parallel wire gauze having 24 strands to the inch, as through the similar wire gauze having 40 strands per inch—when a field of about 1,060 volts to the cm. is applied in each case—although their discharging powers are respectively 1·75 and 12.

§ 2.

Returning to the result shown in fig. 5. It has so far been assumed that the effects observed were due solely to the intensity and distribution of the field around the wires of the middle electrode. A question, however, suggests itself as to whether the whole, or only part, of the diminution in current which is observed when the fields on either side of the middle gauze are in the same direction is due to the withdrawal of ions from the lower chamber; for when the two fields are opposed in direction no ions cross the top chamber, while when the fields are in the same direction, some apparently do cross it.

It seemed conceivable that there still might be something akin to partially combined sets of ions which, although unaffected by the weaker field of the lower chamber, produced ionization in the top chamber under the influence, not merely of an intense field, but as the result of ions moving in an intense field, through clusters such as have been already suggested. This would also explain the lack of saturation shown in the curves of fig. 6.

An experiment was performed in an independent apparatus. Two ionization chambers, provided with aluminium windows, through which Rontgen rays could pass, were balanced electrically against each other. Through the one was drawn air which had been just previously subjected to the influence of either radium or uranium, the ionization having been subsequently removed by a weak field; through the other chamber a supply of air was drawn at the same speed. No alteration in the balance could be observed.

Again, a ring of copper-wire was made active by exposure to thorium emanation, and placed on the upper surface of the

middle gauze. Readings were taken—*(a)* With the copper ring active, and air which had previously passed over the uranium surface drawn through the chamber. *(b)* With the ring active, but the uranium removed, and still using the draught. *(c)* With air passed over the uranium surface after the activity of the ring had disappeared. The results showed that the amount of ionization produced by the copper ring in air was the same as in the air which had just previously passed under the influence of uranium.

Again, had the want of saturation, shown in the curves of fig. 6, been due to the presence of clusters, or partially combined pairs of ions, an alteration of the shape of these curves might have been expected if the number of ions was reduced without altering the number of clusters. No alteration in the shape of the curves could, however, be detected when the uranium was moved some distance further from the gauze, or even when the ionization was still further reduced by placing along the axis of the tube leading to the gauze a wire maintained at a few volts difference of potential from its surroundings.

Recently a paper by M. de Broglie [9a] has appeared, in which tests similar to those just described have been performed upon the gases coming from flames. His results are in agreement with the foregoing in so far that no clusters are found when water vapour is not present.

Having found no support to the cluster theory, we must look to diffusion for an explanation of the curves in fig. 6. The distortion of the field in the immediate neighbourhood of the wires of the middle gauze and its penetration through the wider gauzes have accounted for the results shown in fig. 5. The came cause, in gradually preventing diffusion of the ions to the lower side of the bottom gauze, will explain the difference in shape of the ionization curves obtained with broad- and with narrow-mesh gauzes, also the approach, in many cases, to the same final value of current, as the field strength is increased.

One difficulty which arises in the foregoing explanation is that while the field exerts its influence through the air spaces of the bottom gauze, if the gauze be positively electrified, negative ions will, of course, be more readily drawn to the lower surfaces and sides of the wires of the gauze than if the gauze were uncharged; and positive ions should, apparently, be similarly repelled with a force which depends upon the strength of the field. Now, it is known [10] that when a

[9a] Le Radium, tome iv., No. 7, July, 1907.

[10] J. J. Thomson, Elements of Electricity and Magnetism.

positively charged body of small size is brought very close to a body of much larger dimensions similarly charged, the repulsion which normally exists reduces in value to zero and changes to an attraction when the small charged body is brought within a certain critical distance of the surface, this distance depending upon the charges on the small body and the surface, respectively, and on the curvature of the surfaces. This seems to offer the explanation of the marked difference which exists in the shapes of the ionization curves obtained with broad- and with narrow-mesh gauze, as the field strength is varied; for in the case considered positive ions are blown by the current of air against the lower gauze surface, which is but weakly electrified when the field in the chamber above is weak. As the field in the chamber is increased the fringe, which passes through the gauze, is strengthened, and the force which is exerted upon the positive ions by the draught is not sufficient to bring them to within the critical distance of the lower surface of the gauze to cause attraction. As the positive ions in air are larger and more massive than the negative, it is to be expected, when the lower gauze is negative, that for a given field in the chamber above, less negative ions would be received by the electrometer gauze than in the corresponding case where the bottom gauze is positive. This, we have seen, does occur when the field is weak. Since, when a strong enough field is applied, the same maximum value of current is obtained, whether the bottom gauze be positive or negative, and also for a large range of gauzes exposing very different amounts of surface, the most natural conclusion is that under such circumstances all the ions of one sign which reach the lower surface of the gauze are drawn through the gauze without loss in number and are then collected by the central electrode.

§ 3.

It has been shown by Bragg and Kleeman that the lack of saturation in a mixture of air and ethyl-chloride is considerably greater than for air. Their theory of initial recombination explains this difference, and one of the objects in view at the commencement of the present experiment was to decide whether such an effect persisted for a time after the act of ionization by an α particle had been completed.

As the results so far obtained show the difficulty there exists in eliminating the effects of diffusion when the ions are blown through gauzes, a comparative test between the behaviour of such a vapour as ethyl-chloride and air seemed as much as could at the time be safely derived.

It was arranged to pass a mixture of ethyl-chloride with a small proportion of air from one gasometer through the

gauze chambers which have been described in fig. 4 to a second gasometer. A gauze was inserted, and enabled the draught to be carefully adjusted during each observation. Readings were taken with the lower gauze at potentials of 50 and 600 volts respectively. The depth of the chamber was 11 mm. The mean value of the ratio of the readings with the fields of 555 volts per cm. and 45 volts per cm. was found to be the same for the mixture of ethyl-chloride and air as it was for air only, its value being 1·05. Nitrous oxide was similarly tested, and gave a similar result. The velocity of the gas through the chamber was, in these experiments, about 5 cm. per second. The uranium was 5 cm. below the bottom gauze, so that approximately two seconds elapsed before the products of ionization from the centre of the uranium cylinder reached the gauze. Change in velocity of the draught was found to have no appreciable effect upon the result. The experiment indicates that air, ethyl-chloride, and nitrous oxide, although giving distinctly different ionization curves when the ionization is measured in the presence and during the influence of the ionizing agent, show no difference in behaviour from each other when the ionization is collected from them after their removal for a period of two seconds or more from the influence of the ionizing agent.

§ 4.

It was now deemed advisable to make use of the second method of experiment, as mentioned in the introduction.

The general arrangement of the experiment was such as to allow the α radiation from radium to act for some little time upon the gas to be experimented upon, this being enclosed in a suitable ionization-chamber, and both electrodes meanwhile being connected to earth. A lead screen was quickly interposed between the radium and the chamber: the electrometer electrode was simultaneously disconnected from earth, and a strong field immediately applied between the electrodes. The field was left on for a time, sufficient to ensure all the ions to reach the electrodes. It was then removed, and the charge, which had been collected on the insulated electrode, was measured by a quadrant electrometer. The radium bromide was held in a small metal cup placed at A (fig. 8) some little distance below the floor of the ionization-chamber B. This chamber consisted of a brass case connected to earth; in its floor was cut a circular opening of 1·2 cm. diameter. The hole was covered by a thin sheet of mica, F, which rendered the case gas-tight, but was thin enough to enable the α radiation to penetrate between the

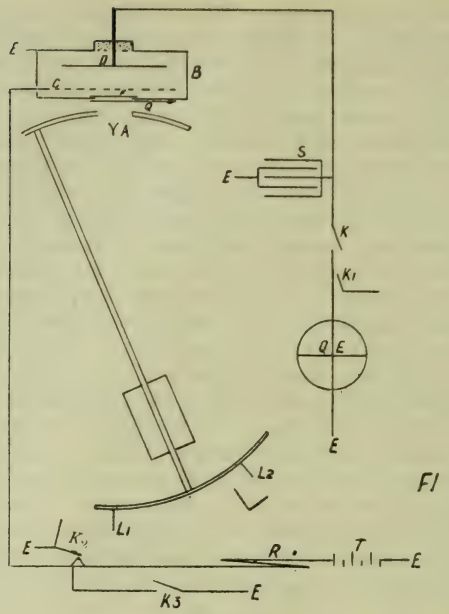


Fig. 8.

electrodes. For introducing gas to the chamber a metal plug was provided, which could be screwed into the opening below the mica, and while air was being exhausted from the chamber a small screw, operated from the outside, enabled a by-pass to be opened between the space on either side of the mica sheet. The lower electrode, C, consisted of a brass gauze insulated from the case, attachment to it being made from the outside by an insulated wire. The upper electrode, D, consisted of a brass plate 8 cm. diameter, supported by a rod passing through sulphur insulation and being connected to one set of plates of a sliding condenser as in the experiments of Langevin.[11]

An aluminium semaphore, G, enabled the α rays to be entirely shut off, when necessary, during the swing of the pendulum without reducing to any great extent the β and γ radiation which entered the chamber. A plate of lead, H, about 2 mm. thick, attached to the pendulum, was arranged so as to swing between the radium and the opening in the ionization-chamber. In this lead plate was cut a hole 1·5 cm. square, and the amplitude of swing was such that the α rays

[11] Ann. de Chim. and Phys., 7me ser., tome 28-39, 1903.

could pass into the chamber only for a short period during the motion of the pendulum. The pendulum at the same time operated a contact K_2 by means of the pin L_1, and this operation connected the electrode, C, to a high potential derived from the small accumulator cells, T, joined in series with a high resistance, R. Prior to the movement of the pendulum these cells were connected to earth through the key, K_2. A second pin, L_2, attached to the pendulum, operated another key in such a way as to complete an auxiliary circuit which released a second pendulum at a definite instant. This second pendulum, after an interval of 1.25 sec., operated a second relay, which connected the electrode, C, to earth by means of the key, K_3.

The pins, L_1 and L_2, could be set in any position upon the pendulum, and by this means the field between the electrodes, C and D, could be applied at any definite instant during the swing of the pendulum, and removed after always the same lapse of time, viz., 1.25 sec. With the range of field strength employed, this time was sufficient to allow for the collection of all the ions which had been produced by the α particles crossing the chamber.

The distance between the electrodes, C and D, was adjustable. To make the effects of ordinary recombination small it was advisable to keep the distance between C and D small, but as this decreased the volume of gas which could be ionized, it was found necessary to work with a distance between the electrodes of 1·8 cm.

To perform an experiment, the pendulum, having been drawn to one side and held by means of a catch, the lead plate, H, was set so as to screen the chamber from the radium, the keys, K, K_1, K_2, being closed, make contact to earth, the key K_3, being left open. The second pendulum was drawn aside and held in position by a clutch. The condenser was closed. By means of electromagnets the main pendulum is released, and at the same time the key K raised. The pin, L, is set so that the gauze, C, is not electrified until the lead screen, H, again shuts off the radium; L_1 and L_2 then strike their keys respectively at the same instant; C is thus electrified, and the second pendulum set swinging. The first pendulum is caught at the end of its swing. When the second pendulum has accomplished its swing it causes the key, K_3, to be closed, and the gauze C is thereby connected to earth.

A constant interval of 4 sec. was now allowed before opening the condenser, S—this for each reading—and at the end of that time the electrometer was disconnected from earth by K, and the key, K, closed. The charge communicated to the electrometer was measured in terms of the first and

second swings by the formula deduced by Langevin, i.e., $\theta = \frac{\epsilon^1 + m\epsilon}{1+m}$ where θ is the charge communicated to the electrometer, and ϵ and ϵ^1 are the first and second swings, and m a factor which in this case had a value of ·65. Even with the sliding condenser it was not possible to eliminate small effects due to rise of potential in the system, D, when the gauze, C, was electrified.

To make sure that this effect as well as leakage was eliminated by subtracting readings with the semaphore on and off a separate experiment was performed. The pin, L, was set so that the field was on all the time the chamber was exposed to the α radiations. Results of experiments with the semaphore on and off were subtracted. The curve obtained showed close agreement with that obtained with the pendulum removed (and the saturation curve obtained in the ordinary manner) and formed a valuable check upon the reliability of the whole apparatus.

In this form of experiment ordinary recombination is not eliminated, and to allow for it we must consider the arrangement of the ions in the chamber, as they cross it under the influence of the field. As shown by Langevin, if in the first place the ions be assumed to be uniformly distributed

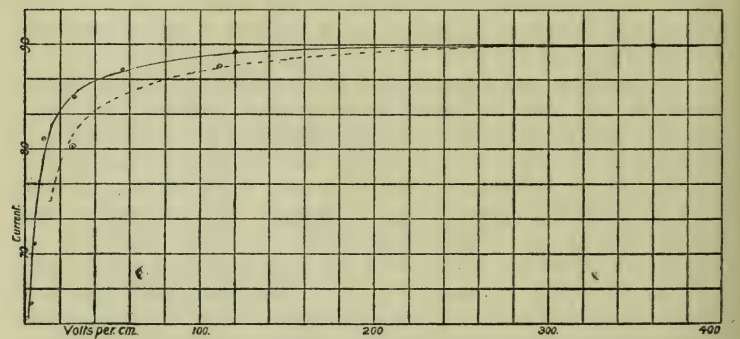


Fig. 9.

and the velocity of the positive and negative be v cm. per sec. under unit $P.D.$ (per. cm.), the time taken for an ion to move across the chamber from electrode to electrode $= \frac{L}{v}$ where L is the distance between electrodes. If time be reckoned from the instant the field is applied, after an interval of time $\frac{L}{2v}$ recombination will have ceased. The number of ions lost

by recombination in crossing the chamber will be $\alpha \int_0^{\frac{L}{2v}} l\ n^2\ dt$ where N is the density of the ions in the space of length, l, at a time, t, from the start:

$$\alpha \int_0^{\frac{L}{2v}} (L - 2vt) \left(\frac{N}{1 + N\ \alpha\ t}\right)^2 dt = NL - \frac{2v}{\alpha} \log_e \left(1 + \frac{N\ \alpha\ t}{2v}\right)$$

Hence a curve can be plotted as in fig. 9, showing the relation between field strength and the number of ions which reach the electrode starting with a given initial density.

In fig. 9 the full line curve is drawn according to the formula which has just been deduced, the value of N being determined in the usual way from a knowledge of the value of the saturation current, the capacity of the system, and the dimensions of the ionization chamber. The value of the N was $5 \cdot 10^6$ ions per cub. cm. The circles show the results of experiments upon air, and it will be seen that they fall very nearly upon the theoretically determined curve, showing that ordinary recombination is sufficient to account for the observed effects. However, it is necessary to show that the effect due to initial recombination was large enough to be detected had it been present.

Using for comparison currents at field strengths of 390 and 80 volts per cm., it will be seen from the curves given by Bragg and Kleeman, in their paper upon "Initial Recombination," that between these values of field strength a very considerable percentage of initial recombination is observable when the ions are collected in the presence of the ionizing agent; but the exact amount depends upon the speed of the α particles producing the ionization. By removing the pendulum and obtaining saturation curves in the ordinary manner with the apparatus used in the foregoing, it was found that after allowing for the effect of ordinary recombination there remained between these values of field strength a rise of about 5 per cent., due to the effects of initial recombination. This amount was such as could have been readily detected in the pendulum experiments.

As the time which elapsed between the stopping of the action of the ionizing agent and applying the field in these experiments was 1-20th sec., it appears then that no evidence can be obtained from the experiments of the non-completion of the act of initial recombination in air within a period of 1-20th sec. after the act of ionization.

Similar experiments were next performed upon ethyl-chloride. The experimental results are shown on the dotted diagram by (o); again it is seen that ordinary recombination accounts for the results.

By a separate set of experiments, as previously described, it was found that between the values of field strength 390 and 80 volts per cm. a rise of 9 per cent. was to be expected from the pendulum experiments in the case of ethyl-chloride, if the effects of initial recombination had been present. This, again, was of such a magnitude that it should have been readily detected.

In the cases, therefore, of air and ethyl-chloride, which both show large effects due to initial recombination when the ions are collected by a field during the action of the ionizing agent, no such effect can be observed when the field is applied as soon as 1-20th sec. after the act of ionization is performed; the act of initial recombination being fully completed within this period.

§ 5.

Having now shown that effects of initial recombination do not last an appreciable time, it seemed possible, by means of the apparatus described in fig. 4, to obtain an independent verification of the theory of initial recombination. For since the arrangement of the gauze in that apparatus made it possible to obtain a measure of the number of ions which reach the lower gauze in any given time, it was to be expected, if the ionizing agent were placed, first, above the lower gauze, and directly in the ionization chamber; and, secondly, just below that gauze, with a current of gas carrying the ions into the chamber; that, after making proper allowances for the effect of ordinary recombination in the latter case, the current obtained in the first case should be much greater than in the second.

For the purpose of obtaining a steady draught, and at the same time to work under any pressure with different gases, the apparatus of fig. 4 was slightly modified. The tubes were placed horizontally, and the gas was circulated by means of a piston moving in a long cylinder, the ends of which communicated to corresponding tubes leading from the ionization chamber. The piston could be moved at a very uniform speed by means of a suitably geared electro-motor. The ionizing agent consisted of a small quantity of radium, enclosed in a lead cell. A V-shaped slit 1·2 cm. deep, with parallel faces ·75 mm. apart, restricted the α rays to a fan-shaped space on emerging from the cell. The cell was placed so that

the slit was in a plane perpendicular to the axis of the ionization chamber, and a small sliding door cut in what has been so far called the lower gauze of the chamber enabled the cell to be introduced when necessary. The air was carried across the radium cell and through the ionization chamber with a velocity of 7 cm. per sec. A thin aluminium sheet, sufficient to stop all the α particles, could be moved over the slit when required, and the difference between the readings without and with this sheet over the slit gave a measure of the ionization produced by the α particles.

In a particular experiment with a piece of tinfoil covering the radium, equivalent to about 1·5 cm. of air at atmospheric pressure, and working under a pressure of two atmospheres, the saturation current with the radium in the ionization chamber corresponded to a deflection of 80 scale divisions in 10 sec. With the radium 8 mm. from the gauze, and with a draught of 7 cm. per sec., the current was 53 scale divisions per 10 sec. Thus the loss of ions in the first ·115 sec. after the ionization was produced = 34 per cent. By increasing the pressure and determining the saturation current with the radium placed directly in the ionization chamber it was possible to determine the greatest density of ionization which had been produced in the previous experiment. An increase of pressure equivalent to a shortening of the range of the α particles by ·34 mm. gave a decrease in current corresponding to 3·0 scale divisions per second.

The section at the opening of the slit was ·08 cm. × 1 cm., the capacity of the system 125 cm., and the electrometer gave a deflection of 340·0 scale divisions per volt. Thus, $4{\cdot}1 \times 10^8$ ions are produced per cub. cm. per second just beyond the slit. The greatest density produced, therefore, in the air as it is blown across the slit is $4{\cdot}7 \times 10^6$ ions per cub. cm. Now, if we suppose all the ionization to be of this same density, the number of ions which will disappear by ordinary recombination in the period ·115 sec. is 36 per cent. The actual number as found was 34 per cent.; it is, therefore, seen that to account for the 34 per cent. difference in ionization which has occurred after ·115 sec., if we are to suppose it due entirely to ordinary recombination, a value equal to that of the maximum density must be assumed for the whole of the ionization. Now it is clear, not only from the geometry of the beam of radiation which is used, but also from the fact that the ionization proceeding from a small heap of radium bromide decreases with the distance from the radium, that the density of ionization in the beam must reach values very much smaller than the maxi-

mum. Since the loss due to recombination depends upon the square of the density, the experiment described indicates the existence (in addition to general) of a process of initial recombination, which is completed within a very short period after the act of ionization.

Summary.

Experiments upon ionized gas blown through gauzes are in agreement with the theory of Bragg and Kleeman, that there exists an initial recombination between a molecule ionized by α rays and the ejected electron or electrons.

Two methods of experiments described show no trace of such effect when the gas is examined 1-10th—1-20th of a second after the act of ionization.

Initial recombination is thus to be considered initial in respect to time.

The action of gauzes, electrified or unelectrified, upon ionized gases blown through them is to be explained by the aid of the theory of diffusion.

An arrangement of gauzes as herein described allows of the removal by an electric field of all the ions of one sign from a very defined region in a tube along which the ions are carried by a current of gas.

The ionization produced in air by Röntgen rays or by a wire made active by exposure to thorium emanation is the same in air which has just previously passed under the influence of uranium radiation as in air not so treated.

In conclusion, I wish to express my indebtedness and sincere thanks to Professor Bragg for suggesting these experiments, and for much advice and help during their progress.

University of Adelaide, 1907.

An Experimental Investigation of the Nature of γ Rays.—No. 2.

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In a previous paper (Trans. Roy. Soc. of S.A., 1908, p. 1) we have given a preliminary account of an investigation of the properties of the secondary radiation due to γ rays, and discussed the evidence thus afforded as to the nature of the rays. The first section of the present paper contains an account of further experiments, and the second a list of the properties of the secondary radiation, derived in part from the work of other observers, and in part from our own. In the third we have tried to show that the properties are readily explained if the γ rays are supposed to be material, but are not easily to be reconciled with the ether-pulse hypothesis.

§ I.

In the former paper we showed that on the neutral-pair hypothesis the connection between the amount of secondary β radiation emitted from the front side of a plate struck by γ rays and the atomic weight of the material of the plate should be approximately the same as for the β rays. It is, of course, known that this is actually the case. Also, we showed that the β radiation emitted from the other side of the plate, the side from which the γ rays emerge, should be the same for all substances, provided three things were true, viz.: —

(1) The γ rays were homogeneous;
(2) The γ rays were absorbed according to a simple density law;
(3) The β rays were also absorbed according to such a law.

If these laws did not hold, and to the extent to which they did not hold, the "emergence" radiation would not be the same for all substances.

The experimental evidence which we submitted showed that the emergence radiation was not connected with the atomic weight of the material by the same law as that which held for the incidence radiation and for β rays: that it was

much more nearly the same for all substances, and that such differences as existed (*e.g.*, carbon generally gave more than lead) appeared to be proper, in view of the conditions stated above. As the results we had obtained seemed to be sufficient to give a criterion between the material and the ether-pulse theories, we thought it right to publish the details of the work as far as we had carried it.

We have now made a more thorough investigation of the nature and amount of emergence radiation. We believe that we are in a position to connect together all the effects attendant on the absorption of the γ rays, and the consequent production of β rays, to a first approximation at least. Included in these effects are some which have come to light during this work, the neutral-pair theory having led us to their discovery.

It is not a very easy thing to obtain an exact measure of the emergence radiation. When a stream of γ rays is shot into an ionization-chamber through a plate forming one of the chamber walls, a very large proportion of the ionization produced is actually due to the emergence rays of the plate. But if the plate is taken away, the place of these rays is supplied, to a varying extent, by secondary rays, made in the air or emergent from the last substance traversed by the rays. A normal stream of γ rays always contains β rays; if these are stopped by a screen, fresh β rays emerge from the other side of the screen. It is impossible, therefore, to measure the emergence rays by subtracting the value of the current when the above-mentioned plate is not in position from the value when it forms part of the chamber wall. Such an operation might conceivably show a negative emergence radiation.

It is, in fact, necessary to remove the β rays from the stream of γ rays by some means which is more effective than a screen. A powerful magnetic field can considerably purify the γ-ray stream for a short distance along the path. Owing to the action of the air, β rays will reappear again in measurable amount after the rays have traversed a few centimetres; nevertheless, we have found the method to be fairly satisfactory so far, and will doubtless be able to improve it when better information is available for the calculation of the remaining errors. The method has already been employed by G. Kucera (Bulletin International de l'Académie des Sciences de Bohême, 1905), but it was finally abandoned. because the magnetic lines of induction penetrated the ionization-chamber, and affected the paths of the secondary β rays, and therefore the magnitude of the current. We therefore placed a thick iron screen (2·5 cm.) between the magnet and the chamber; the γ rays passed through a hole in the iron.

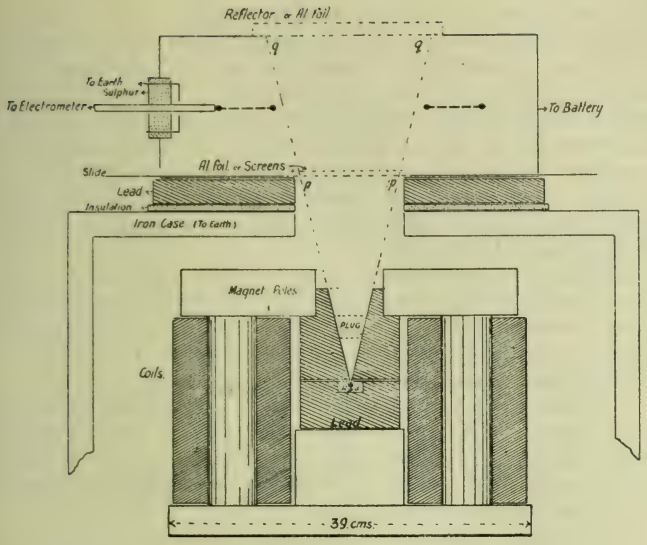

Fig. 1.

This quite satisfied the purpose for which it was intended, and we were therefore provided with the means of testing the effects of a γ stream fairly free from β rays. We used a magnetic field of about 2,500 units. The details and dimensions of the apparatus are shown in fig. 1. The radium was placed at the bottom of a conical hole made in a massive lead block. Plugs of various materials and different thicknesses were turned to fit exactly in the hole. The screens were brought to the position p,p by means of a sliding frame, which passed through an opening in the side wall of the ionization-chamber. This was done to avoid the necessity of opening up the chamber, an operation which often makes readings unsteady for a short time. The electrode consisted of two concentric circles of thick copper-wire, connected by short crosspieces, as shown. The chamber itself was kept at 400 volts. The radium was a fine specimen, which Dr. Herman Lawrence, of Melbourne, was so very kind as to lend us. It was contained, when we received it, in a small brass vessel covered with mica, over which a little wax had been run. Being very anxious to avoid any trace of emanation escaping into our apparatus, and at the same time to run no risk of injuring the specimen, we covered it still further with asbestos, placed the whole in a thin brass vessel, just big enough to hold it, and soldered down the lid. Thus the radium was at all times sufficiently screened

to cut out most of the normal β rays, and, indeed, some of the soft γ rays as well. The Dolezalek electrometer was fitted with a fine quartz fibre: one volt moved the scale-image through four metres. The zero was fairly steady, and consecutive readings generally agreed to three per cent.; the differences were by no means wholly due to the electrometer. As appears to be usual in the measurement of such small currents, we were somewhat troubled by unaccountable disturbances, but on most days these were not enough to interfere with the general results.

Having set up the apparatus in this way, we proceeded first to compare the incidence and emergence radiation of various substances. This was done by the measurement of the current under three different arrangements: —

(a) When those parts of the top and bottom walls of the chamber through which the γ rays passed were made of the thinnest Al foil (p,p and q,q, in the figure);

(b) When a plate of the substance, of proper thickness, was so placed at p,p that the rays passed through it into the chamber;

(c) When a plate of the same substance was made to form part of the top wall, at q,q, so that the γ rays struck it after crossing the chamber.

We took $b-a$ as a measurement of the emergence radiation, $c-a$ as a measurement of the incident. Some results which we obtained in this way are contained in the following table, in which the numbers refer to the movement of the scale in 30 seconds, 10 = 1 mm.: —

TABLE.

Comparison of emergence and incidence radiations.

	Soft γ rays.		Hard γ rays.	
	Incidence.	Emergence.	Incidence.	Emergence.
C	170	2280	58	1150
Al	280	1810	120	795
S	340	1575	154	685
Fe	487	1350	163	560
Cu	558	—	202	523
Zn	618	1160	224	485
Sn	1051	1170	333	303
Pb	1723	2001	497	470

The figures here given show the very large want of symmetry between the radiations on the two sides of a plate. Our previous experiments proved the existence of this want of symmetry; but it is now shown more clearly and satisfactorily.

The results still require correction before they can be considered accurate. It will be clear that $b-a$, the emergence

radiation, is too small in all cases, because the screen, when placed on the bottom of the chamber, stops a certain amount of β radiation, which is made in the air just underneath the plate, and is out of reach of the magnet, as well as some fast β radiation which comes from lower down, and is strong enough to escape from the magnetic field. This is reckoned in a, but not in b; so that on this account all the emergence radiations are too small by a certain constant amount. We have not yet succeeded in determining this constant with any accuracy. We believe it to be mainly due to the fast β rays, which emerge with hard γ rays from the upper surfaces of the magnet poles, of the lead block, and of the plug. It cannot be much less when the plug is removed, and must therefore be of more relative importance to the results for hard rays than for soft, since the total observed effects are smaller in the former case. Its magnitude is, perhaps, indicated with some accuracy by the fact that when a lead plug of 3 cm. thickness was used the emergence radiation of tellurium seemed to be nearly zero: the substance had stopped almost as much as it generated. It can easily be seen from what follows that tellurium should probably have less emergence radiation than any other substance, yet it ought to approach half the value for carbon; and this would imply that the value of the constant was about 300 for the hard rays, and perhaps rather more for the soft. On the other hand, $c-a$, the incidence radiation, is too large, because the plate that is placed on top of the chamber at q,q not only gives rise to the incidence radiation to be measured, but also turns back to a greater or less extent the β rays striking it from below. This effect increases with the atomic weight, and must be of some importance in the case or Sn and Pb. As it is clear that these corrections will increase the want of symmetry, already obvious enough, and as we are hardly in a position as yet to make the corrections with accuracy, and as we hope to diminish our experimental errors in the future, we have for the present left these figures uncorrected.

In the first of these papers we showed that the incidence radiation should be somewhat less than p times the emergence radiation where p is the reflection constant of the substance in question for β rays. The above table does indeed show that the ratio of the two radiations increases with the atomic weight, and therefore with p; but the quantitative comparison appears poor. But it is to be remembered that (1) corrections yet to be made will alter the figures somewhat, making, for example, the emergence radiation of Pb greater, and the incidence radiation smaller; (2) the quantity p is somewhat indefinite. It is true that McClelland has made careful mea-

surements of p for various substances; so also has H. W. Schmidt; and the two sets of results do not agree very well. This is not to be wondered at, for the quality of the secondary radiation due to β rays is different to that of the incident, and depends on the nature of the reflector. For instance, there is some very soft radiation, of which half is absorbed in 25 cm. of air. The experimental value of p will therefore depend on how close the ionization-chamber which receives the secondary radiation is placed to the reflecting-surface. It will be largest if the surface is actually within the chamber; and this is effectively the case in these present experiments.

Again, the incidence radiation should be *somewhat less than* p times the emergence radiation; and the words italicized should apply specially to the case of the lighter atoms. Referring back to the argument of our previous paper, it was there pointed out that the cathode radiation, which originated in any layer of the plate and was turned back, was scattered and softened in the process. In determinations of p this effect causes the result to be too high, because slow β rays produce more ions per cm. than fast ones. At the same time, such rays contribute less to the incidence radiation than they would have done if they had possessed the same penetrative powers as the β rays which go on and emerge from the plate. This applies particularly to the lighter atoms, for it is in their case that this scattering and softening effect is so pronounced. (Quality of secondary radiation due to β rays. Trans. Roy. Soc. of S.A., Oct., 1907, p. 300.) This seems a reasonable explanation of the very large differences between the emergence and incidence radiations of the lighter atoms.

It is interesting to observe that the figures for the incidence radiations were obtained by the use of a stream of γ rays fairly free from β rays. So far as we can discover, this condition has not been realized previously. When we have successfully applied the corrections described above, the results should be of considerable interest.

Having carried these experiments sufficiently far to show clearly the want of symmetry between the secondary radiations on the two sides of the plate, we put them aside for the time, in order to compare the emergence radiations of plates of different substances. At the beginning of this paper it was stated that emergence radiations would be the same for all substances, if we could arrange to have (1) homogeneity of the γ rays; (2) a density law of absorption for the γ rays; (3) a density law of absorption for the β rays. All these conditions cannot be realized; but we can go a long way towards satisfying the first two. Wigger has shown that

rays which have passed through 2·8 cm. of lead are then absorbed by different substances according to a density law simply: they do not recognize atomic groupings. We may safely assume that the first condition is then effectively realized also. We therefore placed a lead plug (1·61 cm. in thickness) in the conical opening (see fig. 1), and hoped to find that the emergence radiation, which we then proceeded to measure, would depend only on the absorption of the β rays. For according to our theory equal quantities of γ rays would be converted into β rays in equal weights of different substances; and the subsequent emergence of these β rays into the ionization-chamber would be governed only by their ability to penetrate the layers intervening between their place of origin and the chamber. It is, perhaps, important to observe that we are implicitly making another assumption, viz., that the β rays originating in different substances have the same speed. On the material theory of the γ rays the assumption is natural; it is justified by the general nature of our results, and by special experiments to be described later.

Since the absorption of β rays by substances of small atomic weight is much less than in the case of the large atomic

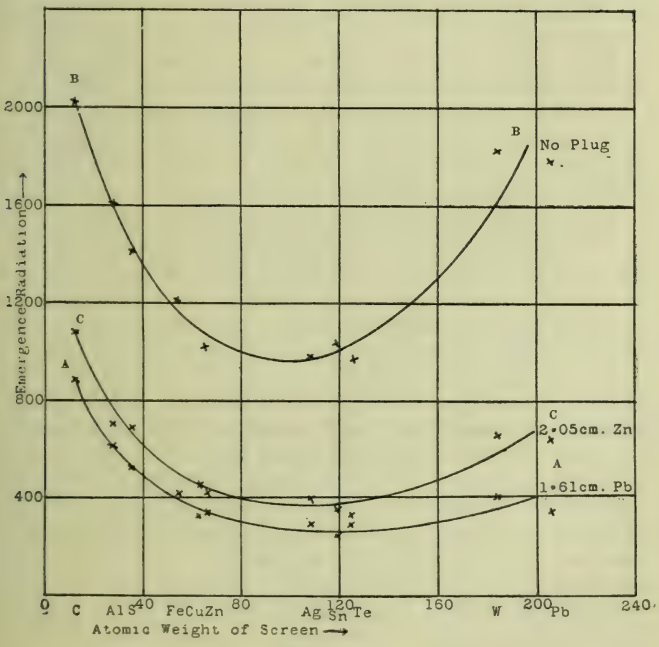

Fig. 2.

weight, weight for weight of screen; or, in the usual phraseology, since λ/ρ is smaller for light atoms than for heavy atoms, we expected the emergence radiations of C and Al to be much greater than those of, say, W and Pb. Fig. 2 shows that this expectation was realized; the results are shown graphically along the curve AA.

The representative points do not lie closely on a smooth curve. To some extent, no doubt, this is due to experimental error, for the measured quantities are very small. But we are inclined to think that the departures from regularity are to some extent real. We hope to settle this point partly by improving our apparatus, and so attaining greater accuracy of measurement, and partly by obtaining better knowledge of the corrections to be applied to the observations. For our present purpose, it is enough to draw a smooth curve such as AA, and to ignore the variations from it.

The figure shows a rapid decrease in the emergence radiations as we proceed from C to Te. There is then a small rise to W and Pb. This is easily explained, and exemplifies a very important feature of the problem. We must remember, not only that λ/ρ is fairly constant for the heavy atoms, but also that the lead screen did not completely remove the soft rays; in other words, that the pencil of γ rays was not quite homogeneous.

This will be clearly understood by comparing the curve AA with the curve BB, which represents the results we obtained when the lead plug was removed and the γ rays had passed through only the wall of the vessel containing the radium before entering the chamber. There was therefore a quantity of soft radiation in the stream of γ rays; the effect was to increase considerably the emergence radiation of Pb and W relatively to that of the other substances. This was as it should have been. We know that hard γ rays pay no attention to atomic structure, but that soft rays distinguish between atoms of different weight. In the table given by Wigger (Jahrbuch der Radioaktivität, 1905, p. 432) the values of λ/ρ for thin sheets of Pb and Zn are ·068 and ·039 respectively; but when the rays have been hardened by passing through 2·8 cm. of lead, each co-efficient has become nearly ·02. Thus, the hard rays treat lead and zinc alike, but softer rays are more absorbed by the former than the latter, weight for weight. When a stream of γ rays is passed through a lead plate, the soft rays are rapidly converted into β rays. Consequently, a thin lead plate produces a large quantity of emergence radiation, due principally to the slow β rays produced by the soft γ rays. The effect is further discussed later on in the paper. But this is rapidly used up; conse-

quently, the radiation measured on the far side of a lead plate is relatively large when the plate is thin, and falls off more quickly at first than it does subsequently, the plate being gradually thickened. The logarithmic curve of Pb has a rapid initial fall, as several observers have shown. But there is a difference in the case of Al or any substance of small atomic weight. The soft γ rays give rise to much less secondary radiation, and, moreover, they are not used up so fast. Both these causes operate to make the logarithmic absorption curve of Al more nearly a straight line, as is actually the case.

It appears that a screen of any material absorbs the soft rays faster than the hard. Consequently, for example, a zinc screen or a lead screen may be used indifferently in order to reduce the ratio of the emergence radiation of lead to that of zinc. But a screen of large atomic weight acts more rapidly. If the screens of lead and zinc are chosen of such thicknesses that they absorb hard rays to an equal extent, then the former absorbs more of the soft rays than the latter. The curve *CC* (fig. 2) shows the results which were obtained when a zinc plug of 2·05 cm. thickness was placed in the conical opening. In both *CC* and *AA* the value for Sn is a little too small; we were not aware at the time that our Sn plate

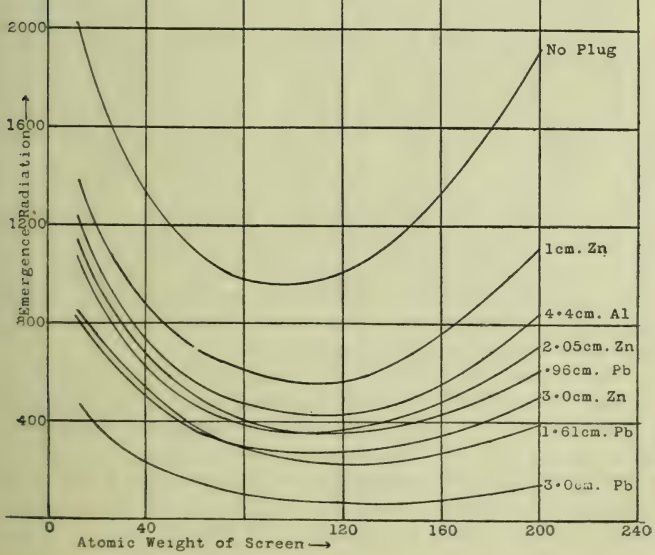

Fig. 3.

was rather too thin. In fig. 3 are drawn several curves, each showing the result of using some particular plug. In order to avoid confusion the representative points are not marked. The effect under discussion is clearly seen on comparing, for example, the curve for 1·61 cm. of Pb with that for 3 cm. of Zn. Kleeman was the first to show that the distinction made by the γ rays between different atoms in regard to the amount of secondary radiation produced by them could be modified by screening (Phil. Mag., Nov., 1907). Our results agree with his to this extent, but they do not show any true selective absorption, such as he supposes.

We may add that when using a different specimen of radium, with which we were able to allow the γ rays to act with a minimum of previous screening, the emergence radiation of Pb was greater than that of C. It would appear probable that with very soft rays other atoms lighter than Pb would surpass C in the same way, and that it is quite conceivable that the emergence radiations should increase with the atomic weight throughout the whole range. In a letter to "Nature" (April 2, 1908, p. 509) Cooksey shows that in the case of X-rays the emergence radiations are greater than the incident, thus proving the parallel to our own results in the case of γ rays. He also finds that the emergence radiation increases with the atomic weight. This is the opposite to what we have found true of the γ rays in most cases; but it is clear that it can be quite in accord with our theory.

When the screen through which the γ rays pass on their way into the chamber is gradually increased in thickness, the emergence radiation rises rapidly to a maximum, and then slowly decreases. The rise is due to increasing β radiation from the thickening screen; the decrease to the absorption of the γ rays by the screen. There is a maximum when the two effects balance. This was clearly shown by Wigger *(loc. cit.*, p. 429). If we determine the thickness which gives half the maximum value, we obtain an easy and fairly accurate measure of the penetration of the secondary β rays. It is easily shown that this particular thickness is also that which would absorb half the equally penetrating radiation from a radioactive layer, assuming an exponential law, which it is permissible to do with sufficient accuracy.

The results are shown graphically in figs. 4 to 8. In each case the curve *A* represents the result of an experiment in which the lead plug, 1·61 cm. in thickness, was used to screen the γ rays. The curve *B* shows the result with the plug removed. From each curve can be determined the thickness of screen, which gives half the full value of the emergence radiation; the points are marked on the diagrams. The re-

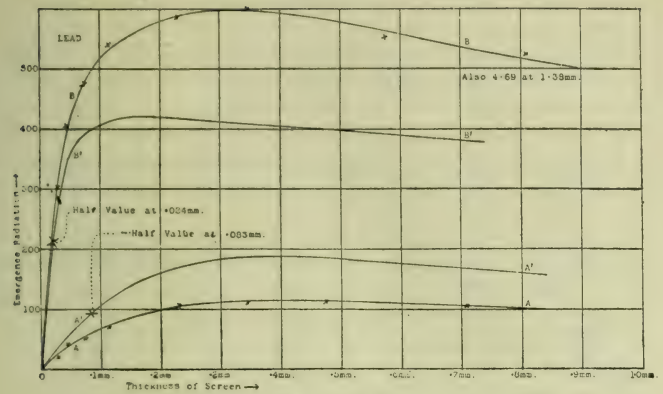

Fig 4.

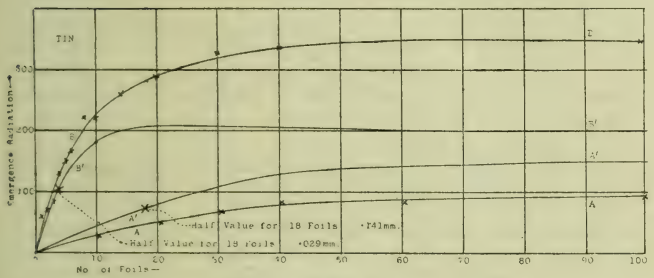

Fig. 5.

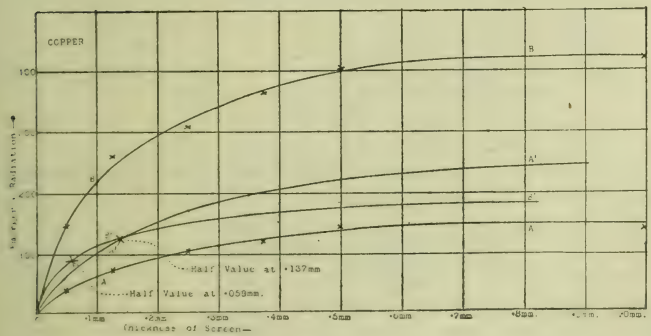

Fig. 6.

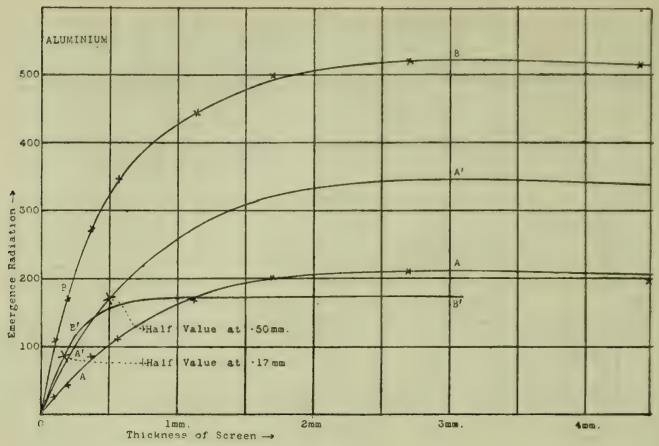

Fig. 7.

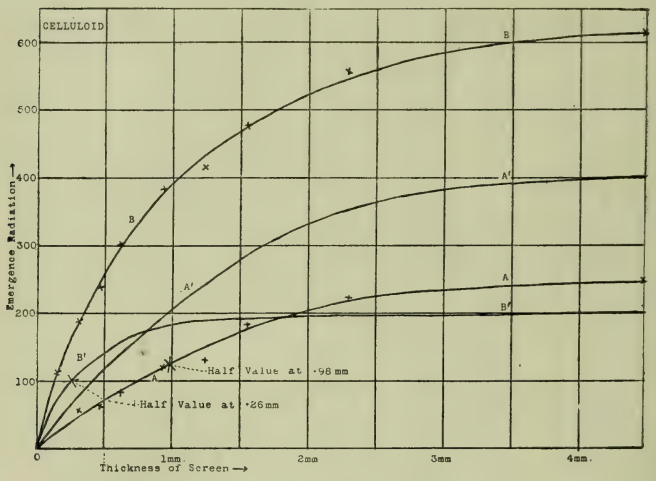

Fig. 8.

sults for the hard rays are collected and shown in the second column of the following table: —

I. Substance.	II. Thickness of Screen to give half-value in mm.	III. λ Calculated from II., in cm^{-1}	IV. λ for β rays. (McClelland and Hackett).
Lead	·083 ...	84 ...	93
Tin	·141 ...	50 ...	52
Copper ...	·137 ...	51 ...	55
Aluminium ...	·50 ...	14 ...	14
Celluloid ...	·98 ...	— ...	—

The third column shows the values of λ calculated from the results in the second column. The fourth column shows the values of λ for the primary β rays of radium, as given by McClelland and Hackett. (Trans. Roy. Soc. Dub., March 22, 1907, p. 49.) A comparison of the two last columns shows clearly that the secondary β rays excited by the γ rays possess nearly the same velocity, no matter in what substance they are excited, and that this velocity is the same as that of the primary β rays. Only hard γ rays have been used to excite the β rays in these experiments, while the values of McClelland and Hackett refer to β rays of ordinary heterogeneity. It is scarcely possible in the present state of knowledge to estimate what allowance should be made for this difference, but it is clear that the main conclusion cannot be affected by it. The value of λ varies rapidly with the speed of the β particle, and there is room for considerable alteration of the values in the table without any important alteration in the associated speed. Nor does much error arise from neglect of the correction discussed above, which makes the emergence radiations too small. The various curves of figs. 4 to 8 should really run a little way past the point taken as origin of co-ordinates.

If we consider the corresponding values for the soft rays, or rather, soft together with hard rays, we find, as expected, that the β rays which they produce are of a much less penetrating character. Also, the difference between the curves A and B is most marked in the case of lead and tin, a result which is in agreement with what has gone before. For these metals the thicknesses of screen required to give half the full emergence radiation are ·030 mm. and ·048 mm. respectively, which may be compared with the values ·083 and ·141 obtained when hard rays were used. The amount of soft radiation is so large that we may consider the effect of the hard radiation mixed with it as a correction to be allowed for. The effect of the hard radiation which has been passed through the plug, 1·61 cm. of lead, is, of course, shown by the curve A. It is a little difficult to say precisely what it would have been if the rays had not gone through the plug, since the absorption co-efficient for γ rays varies so much with the hardness. From ·8 cm. Pb to 1·25 cm. Pb, the value of λ is given by McClelland as ·44 cm.$^{-1}$; from 2·8 cm. Pb onwards Wigger gives ·241 cm.$^{-1}$. We have taken a value between these, towards the harder side, and drawn the curve A' for each metal, derived from A by increasing the ordinates of A by two-thirds, a factor calculated from the absorption co-efficient chosen. Subtracting A' from B, we obtain B', a curve which may be taken as representing approximately the beha-

viour of soft γ rays alone. The form of the curve for both Pb and Sn seems to suggest that the operation has been a success. The half-values are now ·024 and ·029 respectively. Thus the β rays due to these soft γ rays have only one-quarter the penetration of those derived from the harder γ rays. Possibly we have here an association with the facts stated by H. W. Schmidt (Ann. der Phys., Bd. 21, p. 654), viz., that the β rays emitted by RaC consist of two groups, of which one has four times the penetration of the other. The thickness of Al screen necessary to reduce the harder set to half-value was ·53, which agrees with the ·50 given in the table above; for the softer rays the value was ·131, nearly a quarter of the other. If there are two main groups of β rays we should certainly expect to find two corresponding groups of γ rays. Kleeman has also argued in the same direction, though for different reasons.

As will be seen from figs. 6 to 8 we have made the same attempt to sort the soft from the hard rays in respect to Cu, Al, and celluloid as in the case of Pb and Sn. The proportion of soft γ rays converted into β rays is now much less relatively. The results for soft rays are therefore of less accuracy, and depend appreciably on the allowance made for the hard rays. Nevertheless, they are of considerable interest. They show clearly the difference between the effects of hard and soft rays, and the varying proportion of soft to hard from substance to substance.

It may be gathered from consideration of all these curves that secondary γ rays play a very small part in ionizing the air within the chamber. If there were any appreciable amount of it we should expect a gradual rise long after the effect of the secondary β rays had reached its maximum value.

§ II.

We may now give a short summary of the results of this and our previous paper: —

(1) When γ radiation is diminished in quantity in consequence of its passage through matter, β radiation appears in its place, moving at the outset in the original direction of the γ radiation, and subsequently undergoing scattering in the ordinary manner of β rays.

(2) The speed and penetration of the β radiation thus produced increase with the penetration of the γ radiation to which it is due.

(3) The speed of the β radiation does not depend on the nature or condition of the atom in which it arises.

(4) In the case of radium the speed of the β radiation

produced is nearly equal to the speed of the β rays emitted by radium itself. In the case of uranium, thorium, and actinium there are indications that the law holds good also, but no exact measurements have yet been made.

(5) When very hard γ rays traverse matter the absorption and the consequent production of β rays are almost independent of the atomic structure of the matter, and a density law follows. Softer rays are affected by atomic structure, in that the heavier atoms are more absorbent than the lighter, weight for weight; and the softer the rays are the more prominent this effect becomes.

(6) If there are secondary γ rays, the ionization which they produce is negligible compared with that produced by the secondary β radiation, at least within a moderate distance (say 100 cm. of air) of the radiator.

§ III.

Various hypotheses have been suggested as to the mode in which the secondary β radiation is produced by the interaction of the γ (or X-) ray and the atom. It is convenient to divide them into three classes, and to consider to what extent each class is able to furnish an explanation of the properties set out in the summary just given.

To the first class belong those hypotheses which suppose both the energy and the material of the β radiation to be furnished by the atom alone; the γ ray is a pulse which merely pulls the trigger. In its most recent form this idea is put forward by W. Wien (Göttingen Nachrichten, 1907, p. 598).

Secondly, it may be supposed that the energy of the β radiation comes from the γ ray, but the material from the atom. The γ ray is a bundle of electric energy, possessing mass, which impinges on the atom and drives out the electron before it. This is the view now held by J. J. Thomson (Camb. Phil. Soc. Proc., vol. xiv., pt. iv., p. 417).

Thirdly, both the energy and the material of the β ray may be supposed to be derived from the γ ray. The latter is not a pulse but a neutral pair, positive and negative; in passing through some atom the bonds are dissolved, and the negative flies on. (Trans. Roy. Soc. of S.A., May, 1907; Phil. Mag., Oct., 1907.)

Consider first the theory which considers that the whole of the energy of the expelled electron comes from the internal energy of the atom. It is to be supposed that the pulse as it widens finds an atom here and there which is in an explosive

condition, and that in some unknown way it precipitates a catastrophe. There is, of course, one point which is immediately cleared up by such a hypothesis, viz., that the speed of the expelled electron is independent of the intensity or quantity of the primary radiation. But here we stop short, for we have also to explain why the speed of the electron is *not* independent of the quality of the primary radiation. Why should the speed be great when the primary γ rays are hard, and small when they are soft? Why should the velocity of the shot depend on the way in which the trigger is pulled? We might get out of the difficulty by supposing an atom to be like a battery which contained a number of different kinds of guns, and that the pulses were selective, each pulling the trigger of its own particular gun. But even if we have presumed some highly artificial arrangement of this kind, we have greater difficulties still to face. How is it that the pulses always find the guns pointing in the direction in which they are travelling themselves, so that the motion of the shot is a continuation of their own line of flight? For if the speed of the electron is independent of the strength of the pulse, then, so to speak, the touch on the trigger must be very light indeed, and can have nothing to do with the laying of the gun. We might perhaps suppose that there were guns in the battery pointing in all directions, and that the pulse only fired the one which pointed in that direction in which it was travelling itself; but this would require a special atomic structure to meet the case, and it would be out of all proportion to frame such a hypothesis to explain the observed effect. Nor do our difficulties end here. For if the expulsion of the electron is the result of an atomic disintegration, should we not expect the velocity of the electron to vary from atom to atom, as it does in the case of the radio-active substances? It is inconceivable that the explosion of a light atom should result in the expulsion of an electron with exactly the same speed as in the case of the heavy atom. And, further, assuming the same hypothesis, how can the production of β rays, in the case of the hard γ rays, be absolutely independent of atomic structure in all respects whatever?

Thus, after its first small success, the theory breaks down at every point. It is true that Wien makes a tentative application of a theory of Planck, viz., that energy emitted from atoms is divided into definite units, the size of which is inversely proportional to the associate wave length. He thence deduces the law $v^2\lambda = \text{constant}$, where v is the velocity of the ejected electron, and λ the thickness of the X-ray pulse which he is considering. He thus passes by the need of explaining certain of the difficulties just discussed, and arrives at a for-

mula from which the second and third properties in the above summary may be derived. Even then his theory fails to explain the first and fourth properties. It seems to us to be clear that the application of Planck's theory is not justified. And, generally, we conclude that the energy of the secondary β ray does not come from the atom.

We now come to the second case. In this there is no suggestion of trigger action; the energy of the β radiation is supposed to be entirely derived from that of the ether pulses. As already mentioned, this theory has lately been maintained by J. J. Thomson (Proc. Camb. Phil. Soc., vol. xiv., pt. iv., p. 417). It is also discussed by N. R. Campbell ("Modern Electrical Theory"). Since an ether pulse of the orthodox form spreads its energy over wider and wider surfaces as it radiates from its origin, and since the energy of the ejected secondary particle is immensely greater than can be imparted to it during the passage of the weak, and always weakening, pulse, it becomes a necessity on this hypothesis to concentrate the energy of the pulse along radial lines, having their centre at the place where the primary cathode particle is suddenly stopped or accelerated. Thomson speaks of "bundles of energy" occupying only a very small portion of the wave-front, the rest of the front being blank. Of course this at once suggests explanations of some of the difficulties of the γ and X-rays, such as the ionization of only a few of the atoms swept over by the wave, and the absence of relation between the velocity of the secondary electron, on the one hand, and, on the other, the intensity of the radiation and the nature of the atom. Also, it makes provision for a concentration of momentum. This theory, however, postulates a very special and complicated structure of the ether. And, in the second place, it does not even then offer an explanation of all the phenomena.

If a "bundle of energy" provides the energy with which the secondary cathode particle leaves the atom, then the energy-content of the bundle must be greater than the energy of the particle. If, on the other hand, as in the case of the X-rays, the energy of the bundle is derived from that of the arrested cathode particle, the former must be less than the latter. Now, it seems quite clear that the energy of the secondary electron is at least nearly as great as that of the primary cathode particle. For in the case of the X-rays the velocity of the secondary electron is nearly 10^{10}, and is therefore much the same as that of the cathode rays in the bulb. And we have shown above, in the analogous case of γ rays, that the velocity of the secondary β ray, produced by the γ ray, is practically the same as that of the primary β ray, which issues with the γ ray. We must, therefore, conclude on this

hypothesis that the energies of the primary electron, the bundle, and the secondary electron are all equal. The whole of the energy of the cathode particle in the X-ray tube is converted into one energy bundle. This darts away from the anticathode, and sooner or later causes the ejection of an electron from some atom which it traverses, handing over to the electron the whole of its own store of energy. Replace the bundle of energy by a neutral pair, and the whole affair seems simple enough. But surely the complications of the ether structure increase the more closely we examine the process under which rapidly moving electrons in the X-ray tube disappear, and similar electrons, moving at the same rate, appear elsewhere, if we are to consider that the only links between them are little bundles of energy moving with the speed of light.

It might be said, perhaps, that one bundle contains the energy of several arrested electrons; but in that case we should have bundles of all sizes and secondary electrons of all speeds: or that several bundles might pile up their energies in one atom until there was enough for the ejection of one secondary electron; but then we should return to the difficulty of explaining why the speed is independent of the nature of the atom.

A cathode particle cannot give all its energy to a pulse unless its arrest is brought about in a very sudden and special way. The thickness of the pulse must not be greater than the diameter of the electron or corpuscle ("Cond. of Elect.," p. 660). If the pulse is thicker than this, only a proportional fraction of the energy of the cathode particle can be converted into the energy of the pulse. Now it is generally believed that the phenomena of the X-rays require a pulse many thousands of times as thick as the diameter of an electron. It does not seem possible to reconcile these opposite requirements.

The bundle must be excessively small. If it is larger than an atom, or even than an electron, the whole of its energy cannot be given up to one electron on which it impinges. There would not be time for the energy to move in from the outskirts of the bundle to the place where it is being transformed into the motion of the electron. It must not expand or contract its borders as it moves, or else its effect will vary as it travels.

The difficulties of this theory are exactly those which would naturally arise in the attempt to transfer the properties of a material particle to an immaterial disturbance.

Let us now consider the third form of hypothesis, according to which both the energy and the material of the

secondary electron are derived from the primary ray. In our previous paper on this subject, and in papers on "The Properties and Natures of Various Electric Radiations" (Trans. Roy. Soc. of S.A., May and June, 1907; Phil. Mag., Oct., 1907), it was shown that the hypothesis offered a reasonable explanation of all the phenomena known to date. It is only necessary now to show to what extent it fits with the properties of the γ rays enumerated in § II. of this paper. We will take the properties in turn.

As regards (1) we have simply to suppose that the negative and positive, passing united into an atom, are separated if they happen to traverse a very strong field anywhere therein; the negative flies on and the positive becomes ineffective.

The second property is also an obvious consequence of the hypothesis. The faster the γ particle is moving the greater the initial speed of the negative.

The third is readily explainable: the electric field of the atom merely dissolves the bonds that connect the pair. It is not able to affect the speed of the negative set free.

The fourth may be taken to imply that the radio-active atom (say RaC) ejects electrons at certain speeds, some of which start off in company with a positive counterpart, some without. The former constitute the γ rays, the latter the β rays. When the γ rays break up, the negatives so produced have the same speed as the primary β rays.

The fifth would show that there are stronger fields inside heavy atoms than light ones, and that the chance of separation of a pair increases with (*a*) the strength of the field, (*b*) the time taken to cross it.

This is all the explanation that is necessary. We can at least claim that it is much simpler and more complete than any explanation which the ether-pulse theory seems likely to afford, even in its latest form.

It is true that the neutral-pair hypothesis requires the existence of a positive counterpart to the negative electron. In a previous paper it was suggested that this might be an α particle; the results of this paper seem rather to suggest that its mass is only small, and that it may really be a positive electron. Now the positive electron has hitherto been received with little favour; but the argument has been not so much against its existence as against its presence in metals in a free state. The latter is not at all necessary to our hypothesis. We require only that the positive shall exist, that it can be torn from its attachment and carried away by a passing negative electron, and, again, that it can be left behind in some atom which the pair subsequently traverses.

The recent determination by Cooksey of the want of symmetry between the emergence and incidence radiations due to X-rays is the last experiment required to show that all the properties in the summary of § II. are true for X-rays as well as for γ rays, *mutatis mutandis*. All the properties except the first have been already shown to be true (see our first paper on this subject). The complete parallelism between X- and γ rays stands out more strongly than ever.

In conclusion, there is one aspect of the problem which seems to invite a little further consideration. The characteristics of the secondary β ray are independent, as we have seen, of the nature of the atom in which it arises, and depend only on the nature of the γ ray to which it is due. This is all the more remarkable when we consider that the characteristics of primary β rays are peculiarly dependent on the nature of the atoms whence they emerge, and are absolutely independent of physical agencies acting from without. In the one case, that of secondary β radiation, we can determine that a given material shall emit β rays of definite speed and direction, and can carry out our determination by the use of suitable agencies and dispositions. In the other case, that of primary β radiation, the whole process is completely beyond our control. It is one example of this contrast that the radio-active substances do not emit secondary radiations to an abnormal extent. It is clear that there is a sharp line of distinction between the emission of an electron from an atom as a primary β ray, and the emergence of an electron from an atom as a secondary β ray. On our hypothesis the origin of the distinction is simply that in the former case the electron was part of the atom which ejected it; in the latter case, it was no part of the atom: it came in with the exciting ray. All the experimental evidence accords with this view. We come very close to the complete realization of an anticipation made twelve months ago (Trans. Roy. Soc. of S.A., May 7, 1907, pp. 84, 85), "All secondary radiation, other than the δ rays, seems to be in general a rough reflection or scattering of the primary . . . The only cases in which a secondary radiation appears, that is neither δ radiation nor reflected primary rays, are those in which β rays are produced at the impact of X- or γ rays, and in which X-rays are produced by cathode rays. . . . It may well be that further research will bring these cases into better agreement with the rest." On the neutral-pair hypothesis the exceptions mentioned here practically disappear. There remains a broad generalization, which, with all the faults natural to its kind, seems to us to be applicable to every case of which we have knowledge, and to be an important principle of the theory of secondary radiation.

New Australian Lepidoptera of the Families Noctuidæ and Pyralidæ.

By A. Jefferis Turner, M.D., F.E.S.,
Brisbane.

[Read April 7, 1908.]

Family NOCTUIDÆ.

Subfamily AGARISTINÆ.

Argyrolepidia æthrias, n. sp.

(*Æthria*, the sky.)

♂, 39 mm. Head blackish, a pair of spots on crown and sides of face yellowish-white. Palpi yellowish-white, terminal joint, and a spot on external surface of second joint before apex, blackish. Antennæ blackish. Thorax blackish with some whitish scales; posterior edge and two longitudinal lines on patagia yellowish-white. Abdomen grey; tuft, except on dorsum, and under-surface orange. Legs blackish, irrorated, and tarsi annulated with white; anterior coxæ yellowish-white; middle tibiæ orange on external surface. Forewings triangular, costa moderately arched, apex rounded, termen bowed, slightly oblique; blackish; basal area strigulated and spotted with greenish-white; a squarish greenish-white spot on dorsum before middle; succeeded by a small spot, constricted in middle, beyond mid-dorsum; a small bluish-white spot in cell; an outwardly-oblique yellowish-white spot from costa beyond middle, constricted beneath costa; beyond and beneath this a larger spot of the same colour, divided posteriorly into three obtuse teeth; a subterminal series of pale-blue spots; cilia blackish, on apex and tornus white. Hindwings with termen rounded, irregularly dentate; blackish; a large triangular basal area pale metallic blue: cilia white.

This attractive species is nearest *A. novæ-hiberniæ*, Bdv.

Type in Coll. Turner.

N.Q., Cape York; one specimen.

Section AGROTINÆ.

Proteuxoa loxosema, n. sp.

(*Loxosemos*, obliquely marked.)

♂ ♀, 35-40 mm. Head, palpi, and thorax dark-reddish-brown. Antennæ fuscous, towards bases whitish; in ♂ minutely ciliated ($\frac{1}{5}$) with slightly longer bristles. Abdomen pale fuscous. Legs grey, mixed with whitish and brownish.

Forewings elongate-oblong, costa nearly straight, apex rounded, termen rounded beneath; dark-reddish-brown; veins obscurely marked by fuscous and pale-grey irroration; orbicular represented by a minute white dot, reniform by an outwardly oblique, rather irregularly shaped, white bar; a dark oblique subterminal shade, sometimes outlined with whitish, nearly straight, but with small subcostal tooth; beyond this ground colour is paler; cilia dark-grey, mixed with pale-grey. Hindwings with termen rounded, slightly wavy; pale-fuscous; cilia whitish, with a fuscous median line.

Type in Coll. Drake.

V., Leopold, Gisborne, Beaconsfield, in March and April; four specimens received from Dr. Drake and Mr. G. Lyell.

PROTEUXOA SPODIAS, n. sp.

(*Spodos*, ashes.)

♂, 34 mm. Head, palpi, and thorax whitish-grey. Antennæ pale-grey; in ♂ minutely ciliated ($\frac{1}{6}$), with slightly longer bristles. Abdomen pale-grey. Legs whitish. Forewings elongate, costa straight, except close to base and apex, apex rounded, termen rounded beneath; whitish-grey; orbicular and reniform faintly indicated in darker grey; a barely perceptible line of grey dots parallel to termen, midway between that and reniform; cilia pale-grey. Hindwings with termen rounded, somewhat wavy; pale-grey; cilia whitish, with a grey median line at apex.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in March; one specimen received from Dr. Drake.

Section HADENINÆ.

CIRPHIS ORTHOMITA, n. sp.

(*Orthomitos*, with straight threads.)

♂ ♀, 38 mm. Head, palpi, and thorax whitish-ochreous. Antennæ pale-fuscous, towards base whitish-ochreous; in ♂ serrate with moderate cilia (1) arranged in fascicles. Abdomen with dense lateral tufts; whitish-ochreous. Legs whitish-ochreous; three terminal tarsal joints dark-fuscous. Forewings elongate, costa slightly arched, apex rounded, termen rounded beneath; whitish-ochreous; a slender blackish line from base along fold to $\frac{1}{3}$; a shorter, similar line immediately above submedian in posterior part of cell, extending slightly beyond cell; a terminal series of blackish dots between veins; cilia whitish-ochreous, apices barred with dark-fuscous. Hindwings with termen rounded, sinuate; grey; some fuscous terminal dots; cilia ochreous-whitish.

Type in Coll. Lyell.

V., Leopold, in April; two specimens received from Mr. G Lyell.

Section CUCULLIANÆ.

Eumichtis mesophæa.

(*Mesophaios*, dusky in the middle.)

Eumichtis mesophæa, Hmps., Cat. Lep. Phal. VI., p. 343.

♂, 32-34 mm. Head and palpi brown-fuscous. Antennæ fuscous; in ♂ simple with short ciliations ($\frac{1}{2}$). Thorax with a bifid posterior crest; brown-fuscous, an inwardly oblique whitish streak on each patagium. Abdomen with two or three dorsal crests and dense lateral tufts; fuscous. Legs brown-fuscous, tarsi annulated with whitish. Forewings not elongate, costa scarcely arched, apex rounded, termen crenulate, rounded beneath; brown-fuscous; markings dark-fuscous; seven short costal strigulæ between base and $\frac{3}{4}$; three minute whitish costal dots on apical $\frac{1}{4}$; a triangular spot above $\frac{1}{4}$ dorsum; an irregular discal blotch narrower towards dorsum, much expanded towards costa, including orbicular and reniform as transversely elongate, medially constricted, pale areas; posterior edge of reniform outlined with ferruginous; a dentate subterminal line mixed with ferruginous; a fine interrupted terminal line; cilia fuscous, base pale ferruginous. Hindwings with termen rounded, obtusely dentate; fuscous; cilia ochreous-whitish with a fuscous median line not reaching tornus.

Type in Coll. Drake.

V., Beaconsfield, in January; two specimens.

Section ACRONYCTINÆ.

Prometopus poliophracta, n. sp.

(*Poliophraktos*, grey-bordered.)

♂, 32-34 mm. Head grey; upper half of face dark-fuscous. Palpi whitish; basal $\frac{2}{3}$ of external surface dark-fuscous. Antennæ fuscous, towards base whitish; in ♂ serrate and shortly ciliated ($\frac{1}{2}$) in tufts. Thorax whitish-grey; bases of tegulæ fuscous. Abdomen pale-grey. Legs whitish, irrorated with dark-fuscous; tarsi fuscous, with whitish annulations. Forewings elongate, costa slightly arched near extremities, apex rounded, termen rounded beneath; whitish-grey, with scattered fuscous scales; lines dark-fuscous; an incomplete line near base; a strongly dentate line, partly double, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; some brownish suffusion basal to this line; a circular brownish dot edged with dark-fuscous representing orbicular; reniform represented by a

short transverse brownish streak, to the posterior edge of which is closely applied a crescentic whitish streak, edged posteriorly with dark-fuscous; a fine dentate posterior transverse line; some dark-fuscous suffusion in mid-disc and again beyond posterior line, the latter containing some blackish streaks and brownish scales, and forming a sharp wavy subterminal edge; terminal area whitish-grey; a fine fuscous terminal line; cilia grey, with a fine basal brownish line. Hindwings with termen rounded, slightly sinuate; grey; cilia white with a grey antemedian line, on apex and dorsum grey.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in March; two specimens.

CARADRINA CRYPHÆA, n. sp.

(*Kruphaios*, hidden.)

♂ ♀, 32-36 mm. Head and thorax fuscous or brownish-fuscous. Palpi dark-fuscous, apex of second joint more or less whitish. Antennæ pale-fuscous; in ♂ serrate and shortly ciliated ($\frac{1}{2}$). Abdomen grey, sometimes mixed with whitish-ochreous. Legs fuscous, tarsi annulated with whitish; posterior, femora, and tibiæ clothed with long whitish hairs. Forewings elongate, costa scarcely arched, apex rounded, termen rounded beneath; whitish-grey, with some brownish suffusion, especially towards termen, or grey mixed with ochreous-whitish; basal line obsolete, represented by two fuscous dots on costa; a fine dentate transverse line at $\frac{1}{4}$, sometimes double; orbicular obsolete, sometimes a transverse fuscous median shade, from mid-costa obliquely outwards, then bent inwards and again bent to dorsum beyond middle; reniform faintly indicated by a brownish or pale-ochreous suffused spot; a finely dentate postmedian line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, succeeded by some dark streaks on veins; a dark subterminal shade sharply defined posteriorly; a terminal series of indistinct dark-fuscous dots, sometimes obsolete; cilia concolorous. Hindwings with termen rounded; whitish, towards termen suffused with fuscous; cilia fuscous at apex, becoming whitish towards tornus.

Type in Coll. Lyell.

V., Gisborne, Castlemaine, and Murtoa, in March and April; a series received from Mr. G. Lyell.

CARADRINA LEUCOSTICTA, n. sp.

(*Leucostiktos*, white-spotted.)

♀, 26-28 mm. Head and thorax brown; lower edge of face ochreous-whitish. Palpi dark-fuscous; terminal joint

and apex of second joint ochreous-whitish, with a few fuscous scales. Antennæ fuscous. Abdomen brown-whitish, irrorated with brown. Legs fuscous, irrorated, and tarsi annulated, with ochreous-whitish; posterior pair paler. Forewings elongate-oblong, costa straight, apex rounded, termen rounded beneath; brown with a few scattered whitish and dark-fuscous scales; a fine transverse, rather wavy dark-fuscous line at $\frac{1}{3}$; a white spot at $\frac{2}{3}$, representing reniform, sometimes preceded by a similar spot representing orbicular; immediately succeeded by an interrupted dark-fuscous transverse line; a terminal series of white dots; cilia brown mixed with fuscous. Hindwings with termen rounded; ochreous-whitish; cilia ochreous-whitish.

Type in Coll. Drake.

V., Black Rock, near Melbourne; three specimens.

CARADRINA MELANOGRAPHA, n. sp.

(*Melanographos*, inscribed with black.)

♂, 27-29 mm. Head and thorax whitish-ochreous, irrorated with fuscous. Palpi dark-fuscous; apex of second joint whitish; terminal joint whitish, with a few dark-fuscous scales. Antennæ dark-fuscous; in ♂ shortly ciliated ($\frac{1}{2}$). Abdomen ochreous-whitish, irrorated with pale fuscous. Legs dark-fuscous, tibiæ and tarsi annulated with ochreous-whitish; posterior pair mostly ochreous-whitish. Forewings elongate-oblong, costa straight, slightly arched near base and apex, apex rounded, termen rounded beneath; ochreous-whitish, irrorated with brownish-fuscous; a blackish line from costa near base, not reaching dorsum; a white, black-edged dot in disc at $\frac{1}{6}$; a dentate transverse blackish line at $\frac{1}{4}$; a second white black-edged dot at $\frac{1}{3}$; five or six fuscous dots on apical half of costa; a fine blackish dentate line from $\frac{2}{3}$ costa, bent outwards in disc, to $\frac{2}{3}$ dorsum; a dark subterminal shade, twice dentate; a terminal series of black dots; cilia pale-fuscous. Hindwings with termen rounded; whitish, with fuscous suffusion; a crescentic fuscous mark at end of cell; a fine fuscous terminal line; cilia whitish. Ab. Forewings suffused with dark-fuscous, white discal dots sometimes obsolete, subterminal shade edged by an ochreous-whitish line.

Type in Coll. Drake.

V., Black Rock, near Melbourne; four specimens, including two of the dark form.

CARADRINA AMATHODES, n. sp.

(*Amathodes*, sandy.)

♂ ♀, 34 mm. Head and thorax pale-ochreous. Palpi dark-fuscous, terminal joint and apical third of second joint

ochreous-whitish. Abdomen ochreous-whitish. Legs pale-ochreous; tarsi fuscous, with ochreous-whitish annulations. Forewings elongate, costa slightly arched near base, then straight, apex rounded, termen rounded beneath; pale-ochreous; a dark-fuscous dot on costa near base; another at $\frac{1}{3}$, in a line with one at mid-disc, and another above dorsum at $\frac{1}{3}$; a dot on costa beyond middle, from which proceeds a row of fine dots obliquely outwards, then curved downwards to $\frac{3}{4}$ dorsum; orbicular obsolete, reniform represented by a faint crescentic fuscous streak; a darker subterminal shade, sharply outlined posteriorly, with a subcostal tooth; a fine, interrupted fuscous terminal line; cilia pale-ochreous. Hindwings with termen rounded; whitish-ochreous: cilia whitish-ochreous.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in February; two specimens.

CARADRINA NYCTERIS, n. sp.

(*Nukteris*, a night-bird.)

♀, 32 mm. Head, thorax, palpi, and antennæ fuscous. Abdomen fuscous, irrorated with whitish. Legs fuscous, irrorated, and tarsi annulated with whitish; posterior pair mostly whitish. Forewings elongate-oblong, posteriorly dilated, costa scarcely arched, apex rounded, termen somewhat obliquely rounded; fuscous, with some paler scales; an indistinct dark-fuscous dentate line from $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum; orbicular indicated by a minute whitish dot; reniform obscure, dark-fuscous; a very indistinct outwardly-curved pale line at $\frac{2}{3}$; an irregular interrupted pale subterminal line preceded by a darker shade of fuscous; a terminal series of minute whitish dots; cilia fuscous. Hindwings with termen rounded, somewhat sinuate beneath apex; fuscous; cilia fuscous.

Type in Coll. Turner.

N.S.W., Emu Plains, near Sydney; one specimen received from Mr. G. A. Waterhouse.

CARADRINA BASISTICHA, n. sp.

(*Basisteikos*, with basal streak.)

♂, 28 mm. Head pale brownish-ochreous. Palpi dark-fuscous, apex and internal surface pale brownish-ochreous. Antennæ fuscous; in ♂ serrate with short ciliations ($\frac{1}{2}$). Thorax pale brownish-ochreous mixed with fuscous. Abdomen whitish-ochreous, irrorated with pale-fuscous. Legs fuscous irrorated, and tarsi annulated with whitish-ochreous; posterior pair mostly whitish-ochreous. Forewings elongate-oblong, costa straight except near base and apex, apex

rounded, termen rounded, scarcely oblique; brownish irrorated with fuscous; a fine dark-fuscous streak from base along fold to $\frac{1}{3}$; orbicular and reniform indicated by pale spots with darker outlines; indications of dark-fuscous streaks along veins toward termen, ending in terminal dots; cilia brownish-fuscous. Hindwings with termen rounded, somewhat wavy beneath apex; whitish, towards apex and termen suffused with fuscous; cilia whitish with a fuscous line near bases.

The type is not in the best condition; it is somewhat similar to *C. acallis*, Turn., but a browner insect, and readily distinguishable by the basal streak on forewings.

Type in Coll. Turner.

Q., Brisbane, in October; one specimen.

Genus Elesma.

Elesma, Wlk., Brit. Mus. Cat. xxxii., p. 608.
Amaloptila, Turn., Tr.R.S.S.A., 1903, p. 6.

This genus appears to have real affinity with the *Nolinæ*.

Elesma subglauca.

Elesma subglauca, Wlk., Brit. Mus. Cat. xxxii., p. 608.
Amaloptila triorbis, Turn., Tr.R.S.S.A., 1903, p. 6.

N.S.W., Newcastle. V., Beaconsfield.

Genus Epicyrtica, *nov.*

(*Epikurtikos*, hump-backed.)

Frons with a rounded, horny projection, covered with scales. Tongue very small. Palpi slender, porrect, hairy, not reaching beyond frontal projection. Antennæ in ♂ simple, minutely ciliated. Thorax with a dense rounded posterior crest. Abdomen smooth. Forewings with 2 from $\frac{7}{8}$, 3 from angle. 2, 3, and 4 well separated at bases, 6 from upper angle of cell, 7, 8, 9 stalked, 10 connected by a bar with 7, 8, 9. Hindwings with 3 and 4 stalked, 5 imperfectly developed from middle of discocellulars, 6 and 7 stalked, 8 anastomizing with 7 near base.

The affinities of this genus are uncertain.

Epicyrtica lathridia, n. sp.

(*Lathridios*, stealthy, secret.)

♂, 22 mm. Head, palpi, thorax, and abdomen grey mixed with fuscous and whitish. Antennæ grey-whitish; in ♂ with short ciliations ($\frac{1}{2}$). Legs fuscous irrorated, and tarsi annulated, with whitish; posterior pair mostly whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen obliquely rounded; grey; markings dark-fuscous: a distinct line near base, angled beneath costa; a fine line from $\frac{1}{6}$ costa to $\frac{1}{3}$ dorsum, irregularly dentate; an

incomplete circle in disc before middle; an irregularly dentate line from mid-costa to $\frac{2}{3}$ dorsum; three roughly parallel lines from terminal third of costa, converging towards tornus; an interrupted terminal line; cilia grey, apices whitish. Hindwings with termen somewhat sinuate; whitish irrorated with grey; indistinct grey median and postmedian lines; a dark-grey terminal line, obsolete towards tornus; cilia whitish.

Type in Coll. Lyell.

V., Leopold, near Melbourne, in April; one specimen.

Section ACONTIANÆ.

Genus Acachmena, *nov.*

(*Akachmenos*, sharp; in allusion to the thoracic crest.)

Frons flat. Tongue well developed. Palpi ascending; second joint with a strong triangular anterior tuft; terminal joint short, obtuse. Antennæ in ♂ (unknown). Thorax with a sharp, elongate keel-like posterior crest. Abdomen with dorsal crests on first two segments. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 beyond 7. Hindwings with 3 and 4 separate, 5 from mid-way between 4 and middle of cell, 6 and 7 separate.

Acachmena œnocrossa, n. sp.

(*Oinokrossos*, with vinous border.)

♀, 20 mm. Head, palpi, and thorax whitish-red with some reddish-purple irroration. Antennæ fuscous, towards base whitish-red. Abdomen whitish; crests whitish-red. Legs whitish; anterior pair reddish. Forewings triangular, costa straight, slightly arched towards base and apex, apex pointed, termen nearly straight, oblique; whitish-red with sparsely-scattered fuscous-purple scales; two very fine purplish lines, one median, the second at $\frac{3}{4}$; a reddish dot on costa at origin of second line; cilia reddish-purple, apices whitish. Hindwings with termen rounded; whitish, towards termen suffused with pale-fuscous; cilia whitish.

Type in Coll. Turner.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

Genus Alypophanes, *nov.*

(*Alypophanes*, of cheerful appearance.)

Frons rounded, somewhat protuberant. Tongue well developed. Palpi moderate, slender, smooth-scaled, ascending, not reaching vertex; second joint moderate; terminal joint short, tolerably acute. Antennæ in ♂ simple, minutely ciliated. Thorax and abdomen smooth. Legs with outer tibial spurs half length of inner or less. Forewings with a slender

bar-like retinaculum in ♂ ; 7, 8, 9 stalked, 10 free, no areole. Hindwings with 3 and 4 stalked, 5 from mid-way between 4 and middle of cell, 6 and 7 stalked.

ALYPOPHANES IRIDOCOSMA, n. sp.

(*Iridokosmos*, variegated.)

♂ ♀, 18-20 mm. Head rosy; face pale-yellow. Palpi ochreous-whitish. Antennæ whitish; in ♂ with minute ciliations ($\frac{1}{4}$). Thorax rosy, apices of tegulæ and patagia grey. Abdomen grey with some rosy scales; a conspicuous snow-white spot on dorsum of second segment with a lateral rosy spot on each side of it; tuft pale-ochreous. Legs whitish; anterior tibiæ and tarsi fuscous. Forewings elongate-triangular, costa nearly straight for $\frac{2}{3}$, then moderately arched, apex rounded, termen bowed, oblique; ochreous-yellow; a grey spot containing some rosy scales at base; a somewhat quadrangular grey blotch on costa before middle, extending to near dorsum, indented on dorsal aspect, containing a rosy central spot; a large grey terminal blotch reaching to tornus and on costa nearly to apex, its costal edge rosy; leaving a narrow streak of ground colour on apical part of termen; cilia ochreous-yellow. Hindwings with termen rounded; ochreous-yellow; a short median crimson streak from base; a large grey blotch containing some rosy suffusion occupying whole of dorsal and terminal areas, except edge of termen, acutely indented by ground colour in mid-disc; cilia ochreous-yellow, on dorsum grey.

Type in Coll. Turner.

N.Q., Kuranda, in October, April, and May; five specimens received from Mr. F. P. Dodd.

Section NOCTUINÆ.

OPHIDERES PYROCRANA, n. sp.

(*Purokranos*, with fiery head.)

♂, 64 mm. Head iridescent purple, posterior edge reddish-brown. Palpi, second joint iridescent purple, internal surface ochreous; terminal joint long ($\frac{2}{3}$ second), and dilated before apex, fuscous, an iridescent blue spot on subapical dilation on internal and external surfaces, extreme apex pale-ochreous. Antennæ fuscous; in ♂ naked. Thorax reddish-brown with some purplish reflections anteriorly. Abdomen deep yellow, terminal joint fuscous. Legs ochreous, tarsi and apices of tibiæ fuscous, anterior tibiæ densely hairy, above fuscous, towards base reddish-brown, with a pale-ochreous median spot, beneath ochreous. Forewings triangular, costa strongly arched, apex tolerably acute, termen scarcely bowed,

oblique, dorsum with a strong antemedian tooth; dark-greenish; a darker line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum succeeded by a bluish-purple iridescent suffusion; an irregularly pentagonal darker discal spot; a postmedian line from $\frac{3}{4}$ costa to mid-dorsum, preceded by a bluish-purple iridescent suffusion; a similar but less marked suffusion along termen; cilia concolorous. Hindwings with termen rounded; deep-yellow; a blackish terminal band, very broad at apex, narrowing to a point at tornus; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Ischyja cyanopasta, n. sp.

(*Kuanopastos*, sprinkled with bluish.)

♂, 64 mm. Head, palpi, thorax, and abdomen dark-fuscous, very sparsely irrorated with white specks. Antennæ dark-fuscous; in ♂ shortly laminate ($\frac{1}{2}$) with terminal bristles ($\frac{1}{2}$). Legs dark-fuscous, tibiæ densely hairy; posterior tibiæ and tarsi beset with long hairs of paler fuscous with sparse whitish specks, a white spot at base of tibiæ. Forewings triangular, costa straight, arched towards apex, apex round-pointed, termen bowed, oblique; fuscous with bluish-white irroration, sparse in disc, dense towards termen; a dark transverse line, slightly wavy, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, preceded by a brownish line; a dark circular orbicular spot beyond first line and a larger similar reniform spot, both pale-margined; a line similar to preceding from lower edge of reniform to $\frac{3}{4}$ dorsum; a third dark line with brown edges from $\frac{5}{6}$ costa obliquely outwards nearly to termen, then dentate and parallel to termen, meeting second line on dorsum; a circular pale-ochreous spot interrupts third line above dorsum; a triangular dark fuscous apical area beyond third line; cilia concolorous. Hindwings with termen twice angled; fuscous; terminal area, except towards costa, with bluish-white irroration and traversed by a dark-fuscous brown-edged line, which becomes double towards tornus; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Section ERASTRIANÆ.

Genus Auchmophanes, *nov.*

(*Auchmophanes*, squalid-looking.)

Frons loosely scaled. Tongue well developed. Palpi thickly scaled, recurved, considerably exceeding vertex; second joint curved, not reaching vertex; terminal joint rather

short, acute. Antennæ in ♂ (unknown). Thorax and abdomen smooth. Posterior tibiæ with outer spurs not much more than half length of inner spurs. Forewings with 2, 3, 4 well separated and equidistant at origin, 4 from angle, 7, 8, 9, 10 stalked, 7 only short-stalked. Hindwings with 3 from slightly above angle of cell, 4 and 5 stalked, 6 and 7 connate.

Auchmophanes ochrospila, n. sp.

(*Okrospilos*, pale-spotted.)

♀, 27 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-fuscous. Legs pale-ochreous mixed with grey. Forewings triangular, costa gently arched, apex rounded, termen rounded beneath; ochreous-fuscous; whitish dots on costa at $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{2}{3}$; from the last of these a fine irregularly dentate fuscous line proceeds to $\frac{2}{3}$ dorsum; three small circular whitish discal spots in disc, the first at $\frac{1}{4}$, the second and third arranged transversely before middle; a terminal series of fuscous dots; cilia concolorous. Hindwings with termen much rounded; as forewings, but without white spots.

Type (in poor condition) in Coll. Lyell.

N.Q., Mulgrave River, near Cairns, in July; one specimen.

Naarda xanthonephra, n. sp.

(*Xanthonephros*, with yellow kidneys—*i.e.*, reniform spots.)

♂, 25 mm. Head and palpi dark-fuscous. Antennæ fuscous; in ♂ with fairly long ciliations ($1\frac{1}{2}$), and longer bristles (2). Thorax fuscous. Abdomen paler fuscous. Legs fuscous; anterior coxæ, femora, and tibiæ densely hairy except on external surface, which is covered by smooth shining whitish scales. Forewings elongate-triangular, costa distinctly concave in basal $\frac{3}{4}$, apex rounded, termen bowed, oblique; pale-fuscous, darker towards base and costa; suffused darker fuscous transverse lines; first near base; second at $\frac{1}{4}$, preceded by a small roundish ochreous subcostal spot; reniform oval, indented posteriorly, ochreous with two dark-fuscous contained dots arranged transversely; third line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, sigmoid; a faint-whitish subterminal line, deeply waved; a terminal series of black dots between veins; cilia fuscous-whitish. Hindwings much broader than forewings, termen rounded; colour and markings as forewings, but without ochreous spots.

Type in Coll. Lyell.

N.Q., Kuranda, in March; two specimens received from Mr. F. P. Dodd, of which one is in my collection.

CORGATHA POECILOTA, n. sp.

(*Poikilotos*, variegated.)

♂, 20-22 mm. Head and palpi reddish-brown. Antennæ whitish-ochreous; in ♂ shortly ciliated ($\frac{2}{3}$) with a few longer bristles. Thorax pale ochreous-grey. Abdomen pale-purple, towards base pale ochreous-grey. Legs ochreous-fuscous; femora reddish. Forewings triangular, costa scarcely arched, apex rounded, termen with a large obtuse submedian projection; pale purplish-grey, towards costa whitish-grey; costal edge ochreous, interrupted by fuscous; a broad ochreous-fuscous line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, angled beneath costa; three or four dots of same colour representing median discal spot; a fine pale line suffusedly bordered with ochreous-fuscous from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, bent first outwardly then inwardly; some ochreous-fuscous suffusion towards termen; a subterminal series of blackish dots; cilia purple-reddish, apices white, on apex and projection apices fuscous. Hindwings with termen nearly straight; pale purplish-grey suffused with ochreous-fuscous; extreme base and base of costa whitish-ochreous; a reddish band from base of dorsum to apex, interrupted by a large white spot containing two or three blackish scales; cilia purple-reddish, apices white.

Type in Coll. Lyell.

N.Q., Kuranda, in October and April; two specimens received from Mr. F. P. Dodd, of which one is in my collection.

CORGATHA LOXOMITA, n. sp.

(*Loxomitos*, with oblique thread.)

♀, 28 mm. Head, palpi, antennæ, thorax, and abdomen whitish-grey. Legs whitish with some fuscous irroration; tarsi fuscous. Forewings elongate-oval, costa strongly arched, apex acute, termen excised beneath apex, dentate on vein 4, oblique; whitish-grey irrorated with grey; a fine wavy grey transverse line from $\frac{1}{3}$ costa to $\frac{2}{3}$ dorsum; a well-marked, straight, oblique, grey line from immediately beneath $\frac{5}{6}$ costa to $\frac{2}{3}$ dorsum; an ill-defined pale-reddish transversely-oval discal spot containing two grey dots; a subterminal series of grey dots; cilia whitish mixed with grey and brown. Hindwings with termen slightly angled on vein 4; colour and markings as forewings, but without antemedian line and discal spot.

Allied to *C. excisa*, Hmps.

Type in Coll. Turner.

N.Q., Kuranda, in October; one specimen received from Mr. F. P. Dodd.

Maliattha ferrugina, n. sp.

(*Ferruginus*, rusty.)

♂, 18 mm. Head and palpi reddish-brown. Antennæ grey, towards bases brownish; in ♂ very shortly ciliated ($\frac{1}{3}$). Thorax reddish-brown mixed with white. Abdomen whitish with some fuscous suffusion; basal crest reddish-brown. Legs fuscous; tarsi annulated with ochreous-fuscous; posterior legs whitish. Forewings triangular, costa moderately arched, apex rounded, termen bowed, oblique; whitish with some fuscous and reddish-brown irroration; a broad reddish-brown median fascia; its anterior edge fuscous, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; posterior edge fuscous from costa beyond middle, forming a strong, rounded posterior projection, then somewhat concave to $\frac{3}{4}$ dorsum; in median band at base of projection is a transversely oval white spot containing a pair of fuscous dots arranged transversely; a narrow reddish-brown terminal band preceded by a waved white line; cilia fuscous-whitish. Hindwings with termen rounded; pale-fuscous; cilia pale-fuscous with a whitish basal line.

Type in Coll. Turner.

N.Q., Kuranda, in January; one specimen received from Mr. F. P. Dodd.

Zethes hæmacta, n. sp.

(*Hæmaktos*, blood-stained.)

♂, 22 mm. Head, palpi, and antennæ whitish-ochreous mixed with dark reddish-brown; antennæ grey towards apices, ciliations in ♂ very short ($\frac{1}{4}$) with longer bristles (1). Thorax dark reddish-brown. Abdomen grey mixed with whitish. Legs whitish with some fuscous irroration; anterior and middle tarsi dark-fuscous with whitish annulations. Forewings triangular, costa strongly arched near base, then straight to near apex, apex rounded-rectangular, termen rather wavy, with a strong tolerably acute median projection on vein 4; grey-whitish with some scattered reddish-brown scales: a parallel-sided rather strongly outwardly curved dark reddish-brown fascia near base; a similarly coloured blotch on costa at $\frac{2}{3}$, dilated below, reaching to mid-disc; a pale line from costa at $\frac{3}{5}$ obliquely outwards, traversing costal blotch, then bent inwards to $\frac{2}{3}$ dorsum; a subterminal series of dark reddish-brown dots; cilia grey-whitish with some reddish-brown scales. Hindwings with termen strongly dentate; grey-whitish with some reddish-brown scales; a pale median transverse line: a subterminal series of dark reddish-brown dots, that at tornus much larger than the rest; cilia grey-whitish.

I refer *conscripta*, Luc., to the same genus.

Type in Coll. Turner.

N.Q., Kuranda, in April; one specimen received from Mr. F. P. Dodd.

ZETHES CYRTOGRAMMA, n. sp.

(*Curtogrammos*, with curved marking.)

♂, 38 mm. Head, pale ochreous-grey. Palpi ochreous-whitish, second joint irrorated throughout, and terminal joint before apex, with purplish-fuscous. Antennæ whitish-ochreous; in ♂ with minute ciliations ($\frac{1}{3}$) and short bristles (1). Thorax purplish-grey; collar pale ochreous-grey. Abdomen whitish mixed with purple-grey. Legs whitish-ochreous; anterior and middle tarsi purple-fuscous annulated with whitish-ochreous. Forewings triangular, costa nearly straight, apex acute, termen crenulate, acutely angled on vein 4; purplish-grey with a few dark-fuscous scales; a pale, dark-bordered outwardly-curved, transverse line near base preceded on costa by a fuscous spot; a faint, slender, dentate, median, fuscous, transverse line; a dark-fuscous dot in disc before, and another beyond, median line; a pale-ochreous line, doubly edged with fuscous, from $\frac{2}{3}$ costa very obliquely outwards, forming an obtuse projection, then sharply bent to end on $\frac{2}{3}$ dorsum, its angle sometimes joined to termen by a fuscous suffusion: a subterminal series of blackish dots on veins, preceded by a fine dentate line; cilia whitish, on angle sometimes fuscous. Hindwings with termen crenulate, acutely angled on vein 4; colour and markings as forewings; postmedian line similar but straight, basal line not developed.

Type in Coll. Turner.

N.Q., Kuranda, in January and May: two specimens received from Mr. F. P. Dodd.

ZETHES ADOXOPIS, n. sp.

(*Adoxopis*, obscure-looking.)

♂ ♀, 32-34 mm. Head, palpi, and thorax pale brownish-grey. Antennæ whitish-ochreous with some fuscous scales; in ♂ with minute ciliations ($\frac{1}{5}$) and moderate bristles (1). Abdomen whitish-grey irrorated with brown-fuscous. Legs whitish irrorated with fuscous; tarsi fuscous annulated with whitish. Forewings triangular, costa straight, gently arched near base and apex, apex acute, termen crenulate, angled on vein 4; pale brownish-grey; costa with some whitish suffusion; a whitish triangular spot on costa at $\frac{2}{3}$; a darker interrupted transverse line at $\frac{1}{2}$; a fine, acutely-dentate, fuscous line from $\frac{2}{3}$ costa through whitish spot to $\frac{3}{4}$ dorsum; some fuscous dots

on veins representing subterminal line; a fine grey terminal line; cilia brown-whitish. Hindwings with termen wavy, dentate on veins 4 and 7: colour and markings as forewings, but postmedian dentate line succeeded by a suffused fuscous band, and this again by a reddish-brown irregularly-shaped spot in mid-disc.

Type in Coll. Turner.

N.Q., Kuranda, in October and March: two specimens received from Mr. F. P. Dodd.

ERASTROIDES MOLYBDOPASTA, n. sp.

(*Molubdopastos*, lead-besprinkled.)

♂ ♀, 17-21 mm. Head, thorax, and abdomen whitish, faintly greenish-tinged, irrorated with fuscous scales which present a leaden-metallic lustre; face fuscous. Palpi rather short (1½), porrect, terminal joint very short and concealed; fuscous. Antennæ grey; in ♀ whitish with fuscous annulations: in ♂ serrate, with moderate ciliations (1½) in tufts. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; whitish, faintly greenish-tinged, irrorated with fuscous scales showing a leaden-metallic lustre; these dark scales tend to form transverse lines; antemedian at ⅓: postmedian at ⅔, anteriorly suffused, posteriorly well defined, with a median bidentate projection; subterminal indistinct; four white dots on apical ¼ of costa; cilia whitish with fuscous bars and a median fuscous line. Hindwings rather elongate, termen rounded: colour and markings as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in October: two specimens received from Mr. F. P. Dodd.

Genus SYNTHACA, *nov.*

(*Synthakos*, sitting together.)

Frons rounded. Tongue present. Palpi moderately long, porrect: second joint dilated with roughly-spreading scales above and beneath: terminal joint short, smooth, obtuse. Antennæ in ♂ with moderately long even ciliations, and a longer bristle on each joint. Thorax smooth. Abdomen with a dorsal crest on basal segment. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 opposite origin of 7. Hindwings with 3 and 4 connate, 5 from mid-way between lower angle and middle of cell, 6 and 7 connate.

Differs from *Erastria* in the palpi and ♂ antennæ. The species described below has a general resemblance to *Rivula susialis*, Wlk.

Synthaca gilviceps, n. sp.

(*Gilviceps*, with yellowish head.)

♂, 18 mm. Head and palpi pale-ochreous. Antennæ pale-fuscous, towards base ochreous-tinged; in ♂ with moderately long (2), even ciliations and longer (3) bristles. Thorax ochreous-whitish; collar pale-ochreous. Abdomen ochreous-whitish irrorated with pale-fuscous. Legs pale-ochreous mixed with pale-fuscous. Forewings triangular, costa nearly straight, apex rounded, termen bowed, oblique; whitish with fuscous irroration; costal edge tinged with ochreous; an outwardly-curved fuscous line, tinged with ochreous, from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum, interrupted in disc; a similar but broader line from $\frac{2}{5}$ costa to mid-dorsum, obtusely angled outwards in disc; a finer, nearly straight, fuscous line from before apex to before tornus; an interrupted fuscous terminal line: cilia whitish mixed with fuscous. Hindwings with termen rounded; very pale fuscous; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in February; one specimen received from Mr. F. P. Dodd.

Micraeschus prolectus, n. sp.

(*Prolektos*, chosen, preferred.)

♂ ♀, 20-23 mm. Head white; face and palpi brown. Antennæ white; in ♂ with a double row of short pectinations ($\frac{2}{3}$). Thorax grey with a small reddish-fuscous posterior spot. Abdomen grey with some reddish-ochreous scales. Legs ochreous-whitish. Forewings triangular, costa straight, apex round-pointed, termen sinuate beneath apex, then strongly bowed, oblique; pale-grey with a few scattered dark-fuscous scales; a purple-fuscous streak on costa from near base to near apex, interrupted towards apex by three whitish-ochreous dots; a large postmedian purple-fuscous blotch, traversed by a pale line, extending from costa $\frac{2}{3}$ across disc; a purple-fuscous terminal line; cilia orange-ochreous. Hindwings with termen rounded; pale-grey; a pale-reddish suffused median band containing a series of white dots, best developed towards dorsum; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in October; two specimens received from Mr. F. P. Dodd.

Rivula ænictopis, n. sp.

(*Æniktopis*, of obscure appearance.)

♂ ♀, 15-16 mm. Head, palpi, thorax, and abdomen ochreous-whitish. Antennæ pale-fuscous; in ♂ shortly cili-

ated ($\frac{2}{3}$). Legs ochreous-whitish; middle tibiæ of ♂ elongate and with a crest of long scales on dorsal surface. Forewings triangular, costa slightly arched, apex rounded, termen bowed, oblique; ochreous-whitish: a series of whitish dots with darker interspaces on costa, mostly in posterior half; a fine linear transverse mark representing discal dot; a fine ochreous terminal line containing minute blackish dots on veins; cilia fuscous. Hindwings with termen rounded, slightly indented above middle; whitish; a slight fuscous suffusion on termen; cilia fuscous, on tornus and dorsum whitish.

Allied to *R. ommatopis*, Meyr., but much paler and discal spot of forewing much smaller and linear.

Type in Coll. Turner.

N.Q., Kuranda, Geraldton, Townsville, in October, November, March, and April.

RIVULA CRASSIPES, n. sp.

(*Crassipes*, with thickened feet.)

♂, 19 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-whitish; antennal ciliations in ♂ moderate ($1\frac{1}{2}$). Legs ochreous-whitish; middle tibiæ in ♂ elongate, hairy, thickened on dorsal surface with long hairs, which end in a dense fuscous tuft at distal extremity, first tarsal joint also hairy on dorsal surface; posterior tibiæ and first tarsal joint hairy on dorsal surface, the hairs on former forming a distinct tuft before middle. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique, dorsum fringed with long hairs towards base; ochreous-whitish; two or three small fuscous dots representing antemedian line; a pair of dark-fuscous dots arranged transversely and succeeded by some fuscous scales in disc beyond middle; a double series of faintly-marked fuscous dots representing postmedian line, from $\frac{5}{6}$ costa, sigmoid, and bent in to $\frac{2}{3}$ dorsum; a whitish line close to termen, termen narrowly ochreous-fuscous with minute blackish dots on veins; cilia pale-fuscous. Hindwings with termen rounded; pale-fuscous; cilia pale-fuscous.

Easily recognized by the ♂ middle tibiæ.

Type in Coll. Turner.

N.Q., Kuranda, in April: one specimen received from Mr. F. P. Dodd.

ANACHROSTIS ZONOPHORA, n. sp.

(*Zonophoros*, banded.)

♂, 14 mm. Head grey-whitish. Palpi fuscous. Antennæ grey: in ♂ serrate and moderately ciliated (1) in tufts. Thorax ochreous-whitish. Abdomen grey. Legs fuscous; posterior pair whitish. Forewings triangular, costa slightly

arched, apex rounded, termen bowed, oblique; ochreous-whitish with scattered fuscous scales more numerous towards termen, markings fuscous; a triangular spot on costa from base to $\frac{1}{6}$; an irregularly dentate line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum, a similar line from mid-costa to mid-dorsum, the included space wholly fuscous towards costa, elsewhere irrorated with fuscous; a fine, acutely-dentate, whitish subterminal line; preceded by an irregular dark-fuscous subapical spot; cilia fuscous, obscurely barred with grey-whitish. Hindwings with termen rounded; grey; cilia grey.

Type in Coll. Turner.

N.Q., Kuranda, in September and April; two specimens received from Mr. F. P. Dodd.

ANACHROSTIS PLACOSPILA, n. sp.

(*Plakospilos*, broad-spotted.)

♂ ♀, 14-16 mm. Head, palpi, thorax, and abdomen white with a few fuscous and brownish scales more numerous in ♀. Antennæ whitish; in ♂ serrate with rather long cilia (2) in tufts. Legs whitish with fuscous irroration. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; white with some fuscous-brown irroration, more so in ♀; markings fuscous-brown; a spot on base of costa; a small triangular spot on $\frac{1}{4}$ costa; a large quadrangular spot on costa beyond middle; several irregularly-distributed dots in terminal part of disc; an interrupted terminal line; cilia whitish with some fuscous scales. Hindwings with termen rounded; whitish suffused with pale-fuscous, in ♀ fuscous; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in August and October; two specimens received from Mr. F. P. Dodd, of which the ♀ is in Coll. Lyell.

Section HYPENINÆ.

PANILLA MICROSTICTA, n. sp.

(*Microstiktos*, with small spots.)

♂, 32-35 mm. ♀, 28 mm. Head and palpi fuscous mixed with ochreous-whitish. Antennæ fuscous; towards base in ♂ ochreous-whitish with a tuft of scales from anterior surface of basal joint; in ♂ simple, with a double row of tufts of rather long cilia ($1\frac{1}{2}$). Thorax and abdomen fuscous mixed with ochreous-whitish. Legs fuscous, anterior and middle tarsi annulated with ochreous-whitish; in ♂ with a dense tuft of hairs from anterior coxæ, and anterior femora and posterior tibiæ clothed with long hairs. Forewings triangular, costa straight, arched towards apex, apex rounded,

termen crenate, bowed, oblique; fuscous irregularly mixed with ochreous-whitish; orbicular small, roundish, reniform larger, posteriorly indented, both fuscous, reniform with paler centre; an ill-defined, somewhat dentate, fuscous line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, succeeded by a row of minute whitish dots on veins, variably developed, scarcely traceable in ♀; a terminal series of short longitudinal fuscous streaks between veins, running into a fuscous terminal line; cilia fuscous obscurely barred with ochreous-fuscous. Hindwings with termen rounded, crenate; colour and markings as forewings.

Type in Coll. Turner.

N.Q., Cairns: Kuranda: in April and May (Dodd); three specimens.

PANILLA UMBRIFERA, n. sp.

(*Umbriferus*, shaded.)

♂ ♀, 21-23 mm. Head reddish-brown mixed with whitish. Palpi fuscous mixed with reddish-brown and whitish. Antennæ fuscous, beneath ochreous-whitish; in ♂ with a tuft of hairs from upper and posterior aspect of basal joint, slightly dentate towards apex, moderately and evenly ciliated ($1\frac{1}{4}$), with longer bristles. Thorax reddish-brown mixed with whitish and dark-fuscous; a small whitish posterior tuft. Abdomen reddish-brown mixed with dark-fuscous and whitish; dorsal tufts on second and third segments. Legs ochreous-whitish; anterior and middle tibiæ dark-fuscous anteriorly; anterior and middle tarsi dark-fuscous with ochreous-whitish annulations; in ♂ with tufts of very long hairs, partly ochreous-whitish, partly dark-fuscous, from anterior coxæ and femora. Forewings triangular, costa straight, slightly arched towards apex, apex rounded, termen bowed, oblique, crenate; whitish mixed with reddish-brown; markings dark-fuscous mixed with reddish-brown; a basal fascia; a fascia at $\frac{1}{3}$, angled beneath costa; a large triangular spot on costa at $\frac{2}{3}$ from which a slender process extends obliquely outwards to mid-disc; a fine fuscous looped terminal line; cilia purplish with some fuscous scales. Hindwings with termen rounded, crenate; colour and markings as forewings, but without basal fascia and costal triangle, the latter replaced by a fine transverse postmedian line.

Type in Coll. Turner.

N.Q., Kuranda, in April and May; four specimens received from Mr. F. P. Dodd.

Genus CORETHROBELA, *nov.*

(*Korethrobelos*, with brush-like palpi.)

Head rough-haired, frons rounded. Tongue well developed. Palpi ascending, recurved; second joint ascending,

reaching vertex, rough-haired, with a tuft of hairs posteriorly towards apex; terminal joint recurved, long, acute, in ♂ with loose-spreading hairs in front and behind, in ♀ with a tuft of long hairs on posterior surface only. Antennæ in ♂ with minute ciliations and a short bristle on each segment. Thorax smooth; in ♂ with a lateral expansile tuft of long hairs beneath from near origin of hindwings. Abdomen smooth. Coxæ and femora densely rough-haired, especially in ♂. Forewings with 7, 8, 9, 10 stalked, no areole; in ♂ with an elongate scaleless ribbed patch in posterior end of cell beneath, and a dense crest on upper surface on costal edge of posterior part of cell. Hindwings with 3 from well before lower angle of cell, 4 from angle, 5 closely approximated to 4 at origin, 6 and 7 connate, 8 anastomozing with cell to $\frac{1}{4}$; in ♂ with a pecten of long hairs on upper surface on median vein.

Allied to *Nodaria*, Gn., of which it appears to be a development.

CORETHROBELA MELANOPHAES, n. sp.

(*Melanophaes*, dark.)

♂ ♀, 38 mm. Head, palpi, thorax, and abdomen dark-fuscous. Antennæ fuscous; in ♂ with short ciliations ($\frac{1}{2}$) and longer bristles ($1\frac{1}{2}$). Legs fuscous mixed with ochreous-whitish. Forewings broadly triangular, apex rounded-rectangular, termen rounded beneath; dark-fuscous; a white dot in cell at $\frac{1}{6}$; a reddish-ochreous spot, finely outlined with black, beyond cell at $\frac{2}{5}$; in ♀ a few scattered whitish scales, of which some indicate a subterminal line; cilia fuscous-whitish. Hindwings with termen rounded; blackish in ♂, dark-fuscous in ♀; cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in April and May; two specimens received from Mr. F. P. Dodd.

NODARIA NYCTICHROA, n. sp.

(*Nuktichroos*, dark.)

♀, 24 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Palpi very long, ascending, second joint exceeding vertex, posterior aspect clothed with long scales, which extend to apex. Antennæ in ♀ with minute ciliations and moderately long bristles (2). Legs fuscous irrorated with whitish. Forewings triangular, costa moderately arched, apex acute, termen bowed, oblique; fuscous; median area darker, its anterior edge at $\frac{1}{3}$, concave; its posterior edge from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, irregularly dentate; cilia fuscous. Hindwings with termen rounded; fuscous; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Genus Anomophlebia, *nov.*

(*Anomophlebios*, with unusual neuration.)

Frons with an acute anteriorly-directed tuft of scales. Tongue well developed. Palpi long, porrect; second joint long, much thickened with loose scales, especially beneath; terminal joint short, somewhat thickened with scales which extend to apex. Antennæ in ♂ with a double row of long pectinations. Thorax with a posterior crest. Abdomen smooth. Forewings in ♂ with a large fovea in cell, and another between cell and costa: areole present, 8, 9, 10, 11 stalked from areole, 10 and 11 arising by a common stalk from 8 long before 7. Hindwings with 3 and 4 stalked, 5 from middle of cell, 6 and 7 stalked.

The anomalous neuration is perhaps correlated with the presence of a fovea in the forewing and confined to the ♂.

Anomophlebia furtiva, n. sp.

(*Furtivus*, concealed, inconspicuous.)

♂, 24 mm. Head, thorax and abdomen pale-brownish. Palpi pale-brownish irrorated with dark-fuscous. Antennæ brown-whitish; in ♂ with very long (12) slender pectinations extending nearly to apex. Legs brownish with some fuscous irroration. Forewings triangular, costa gently arched towards base and apex, apex rounded, termen bowed, oblique; cell occupied by a foveal depression, and space between cell and costa by a second similar depression, both thinly scaled especially on under surface; pale-brownish; fuscous dots on costa at $\frac{1}{4}$ and middle; a strongly sigmoid postmedian line indicated by several fuscous dots on disc at $\frac{2}{3}$ beyond cell, several beneath end of cell before middle of disc, and one on dorsum at $\frac{2}{3}$; some inconspicuous fuscous terminal dots; cilia pale-brownish. Hindwings with termen rounded; brown-whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Kuranda, in October; one specimen received from Mr. F. P. Dodd.

Olulis subrosea, n. sp.

(*Subroseus*, somewhat rosy.)

♀, 30 mm. Head, palpi, antennæ, and thorax ochreous-whitish. Palpi very long, ascending; second joint much exceeding vertex; terminal joint $\frac{2}{3}$ second, slender, acute. Abdomen ochreous-whitish with some rosy suffusion. Legs ochreous-whitish. Forewings elongate-triangular, costa nearly straight

except near base and apex, apex acute, termen excised beneath apex, acutely dentate on vein 4, thence oblique; ochreous-whitish; some scattered fuscous scales which form obscure markings; indications of antemedian, postmedian, and subterminal lines; a pale-centred median discal spot; a series of dots on veins close to but not on termen; cilia ochreous-whitish. Hindwings bowed on vein 3, wavy between this and apex rounded towards tornus; whitish suffused with rosy.

Type (wasted) in Coll. Turner.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

CHUSARIS RHODIAS, n. sp.

(*Rhodon*, a rose.)

♂, 21-24 mm. Head, palpi, and thorax fuscous-whitish, with a few dark-fuscous scales. Antennæ fuscous, towards bases whitish; in ♂ shortly ciliated (⅔). Abdomen ochreous-whitish densely irrorated, except basal segment and apical tuft, with pinkish. Legs ochreous-whitish; anterior pair irrorated with pinkish; anterior and middle tarsi irrorated with dark-fuscous. Forewings triangular, costa moderately arched, apex rectangular, termen strongly bowed, sinuate beneath apex, somewhat crenulate; ochreous-whitish sparsely irrorated with fuscous and pinkish scales; with tufts of raised scales, which are mostly dark-fuscous; several in basal area; five or six forming a line from ⅓ costa to ⅓ dorsum; two arranged transversely in mid-disc; a series forming a sinuate line from just before apex to just before tornus; a subterminal series of pinkish-fuscous dots; cilia ochreous-whitish, apices pinkish. Hindwings with termen rounded; deep pink; traces of some fuscous subterminal dots near apex; cilia ochreous-whitish mixed with pinkish, the former preponderating towards tornus.

Type in Coll. Turner.

N.Q., Kuranda, in October; two specimens received from Mr. F. P. Dodd, of which one is in Coll. Lyell.

BLEPTINA PANTŒA, n. sp.

(*Pantoios*, of all kinds, variable.)

♂ ♀, 30 mm. Head pale-brownish. Palpi long and dilated with scales, in ♂ strongly recurved, second joint much exceeding vertex; brownish mixed with fuscous. Antennæ pale-brownish; in ♂ with a strong tuft of scales on upper surface beyond middle. Thorax and abdomen brownish. Legs whitish-ochreous mixed with fuscous-brown. Forewings triangular, costa straight, strongly arched before apex, apex acute, termen bowed, oblique; in ♂ with a much enlarged

costal fold on under-surface, extending from base to $\frac{2}{3}$ costa and nearly half across disc; pale-brownish with some fuscous-brown irroration; an oblique darker shade, sometimes followed by a pale shade from costa beyond middle to dorsum before middle; a reddish-brown or dark-fuscous reniform spot, indented posteriorly, immediately beyond this; sometimes a series of fine fuscous dots representing postmedian line, from $\frac{2}{3}$ costa, at first curved outwards, then inwards to mid-dorsum; another series of dots represents subterminal line, in this line below costa is a short linear dark-fuscous lunule, edged posteriorly by a pale line; a terminal series of dark-fuscous dots; cilia fuscous, apices whitish barred with fuscous. Hindwings with termen scarcely rounded; colour and markings as forewings but without discal spot and lunule.

Type in Coll. Turner.

N.Q., Kuranda, in March, April, and July; three specimens received from Mr. Dodd, of which one is in Coll. Lyell.

Catada apoblepta, n. sp.

(*Apobleptos*, conspicuous.)

♂, 40 mm. Head reddish-ochreous; face and palpi fuscous; the latter extremely elongate (8). Antennæ fuscous; in ♂ with tufts of long cilia (3) in basal half, but towards apex cilia are short. Thorax brownish; collar reddish-ochreous. Abdomen ochreous-yellow; apical segments fuscous. Legs whitish; anterior pair suffused with fuscous. Forewings triangular, costa straight, arched before apex, apex rounded, termen obliquely rounded; fuscous; a bluish-white line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, outwardly curved; a similar line from midcosta, sinuate first outwardly then inwardly to mid-dorsum; between median line and base ground-colour is reddish-brown; a dark-fuscous dot in cell between lines; three fine parallel bluish-white lines the first on disco-cellular, the other two immediately posterior; a large whitish subapical blotch; [extreme apex broken, cilia abraded]. Hindwings with termen rounded; ochreous-yellow; a blackish terminal band, very wide at apex, narrowing to tornus; [cilia abraded].

Type in Coll. Turner. Though in poor condition, this is a striking and unmistakable species.

N.Q., Kuranda, in April; one specimen received from Mr. F. P. Dodd.

Genus Hypobleta, nov.

(*Hupobletos*, spurious counterfeit.)

Frons flat with a few projecting scales. Tongue well-developed. Palpi moderate, slender, porrect; second joint rather long, thickened with scales on upper surface towards

apex; terminal joint short, somewhat down-curved, tolerably pointed. Antennæ in ♂ with short ciliations and rather longer bristles. Thorax and abdomen not crested. Anterior coxæ, femora, and tibiæ clothed with long hairs in ♂. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 opposite 7. Hindwings with 3 and 4 short-stalked, 5 from midway between 4 and middle of cell, 6 and 7 connate.

Allied to *Hypenagonia*, Hmps. (Moths Ind. iii., p. 100). The following species might on superficial appearance be referred to the Sterrhinæ (Geometridæ).

HYPOBLETA CYMÆA, n. sp.

(*Kumaios*, wavy.)

♂ ♀, 20-22 mm. Head, thorax, and abdomen whitish or grey-whitish with some scattered dark-fuscous scales. Palpi whitish, towards base dark-fuscous. Antennæ whitish with some dark-fuscous scales towards base; in ♂ with very short ciliations ($\frac{1}{2}$) and rather longer, bristles (1). Legs whitish; anterior pair fuscous. Forewings rather elongate-triangular, costa straight to near apex, apex round-pointed, termen bowed, oblique, crenulate; whitish or grey-whitish, with a few scattered dark-fuscous scales; fine, indistinct, dentate post-median and subterminal lines; a dark-fuscous subcostal dot at $\frac{1}{4}$, sometimes followed by similar dots in a line between this and termen; a terminal series of blackish dots; cilia whitish or grey-whitish. Hindwings with termen rounded, flattened towards tornus, dentate; colour and markings as forewings, but with some dark-fuscous suffusion at tornus.

Type in Coll. Turner.

N.Q., Kuranda, in March and April; two specimens received from Mr. F. P. Dodd.

ARRADE PERCNOPIS, n. sp.

(*Perknopis*, of dusky appearance.)

♂, 21-23 mm. Head, palpi, antennæ, and thorax brown-fuscous. Antennæ in ♂ with short ciliations ($\frac{2}{3}$). Abdomen brown-fuscous, paler towards base; some raised scales on dorsum of penultimate segment. Legs brown-fuscous; posterior pair paler; fore-tibiæ in ♂ dilated with scales at apices. Forewings elongate-triangular, costa slightly concave in basal $\frac{2}{3}$, then gently arched, apex tolerably pointed, termen straight, oblique, not crenulate, at most slightly wavy, dorsum with a triangular scale-tuft at $\frac{2}{3}$; dark-brown; four minute whitish dots on apical fourth of costa; an interrupted dark-fuscous terminal line; cilia brown. Hindwings with termen rounded; pale-grey; cilia pale-grey.

Var. a.—Forewings with a darker basal patch sharply limited by a very oblique line from $\frac{1}{3}$ costa towards, but not reaching, tornus.

Type in Coll. Turner.

N.Q., Kuranda, in February and March; two specimens received from Mr. F. P. Dodd.

ESTHLODORA CYANOSPILA, n. sp.

(*Kuanospilos*, with bluish spots.)

♂, 16 mm. Head, palpi, thorax, and abdomen whitish-grey with a few scattered dark-fuscous scales. Antennæ whitish-grey; in ♂ simple, with moderate ciliations (1). Legs whitish-grey tinged with reddish; tarsi grey. Forewings triangular, costa straight almost to apex, then arched, apex acute, termen with an acute dentate projection on vein 4; whitish-grey, with some scattered brownish and fuscous scales; a suffused reddish spot on base of dorsum, more or less developed, sometimes reduced to a few scales; a straight fuscous line from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum, sometimes faint, sometimes strongly developed; a pair of dark-fuscous discal dots arranged transversely immediately beyond this line; a whitish dentate subterminal line edged posteriorly with dark scales, more or less developed, sometimes pure white towards costa; a reddish-fuscous terminal line, thickened between veins; cilia reddish-fuscous, bases ochreous. Hindwings with termen nearly straight towards apex, slightly dentate on veins 2, 3, 4, deeply incised at tornus; reddish-fuscous, towards costa whitish-grey; a number of bluish-white spots; first and largest in mid-disc before middle, a median transverse series more or less confluent, and a double series before termen; cilia reddish-fuscous. Under side reddish-fuscous; forewing except towards costa and termen ochreous with reddish irroration.

Type in Coll. Turner.

N.Q., Kuranda, in March and May; two specimens received from Mr. F. P. Dodd.

Family PYRALIDÆ.

Subfamily PYRAUSTINÆ.

This group is very largely represented on the North Queensland coast, as is the case in all the tropical regions of the Eastern Hemisphere. Many of the species have a very extensive range, and the synonymy is thereby complicated. The classification of the genera is a task which, after having paid some attention to the subject, I prefer not to undertake at the present time. I include in this group the Hydrocampinæ and Scoparianæ of Hampson. The former, as he defines it, I do not regard as in any sense a natural group,

and the character on which it is based, the stalking of vein 10 of the forewings, is not I think even of generic value. This vein is usually closely oppressed to 8 + 9, and may arise separately, or be partly fused with the latter in closely allied species, and sometimes both kinds of structure may be found in different individuals of the same species.

Genus Elachypteryx, *nov.*

(*Elachupterux*, tiny-winged.)

Frons rounded. Tongue present. Palpi upturned, slender, not reaching vertex; terminal joint slender, acute. Maxillary palpi very short, filiform. Antennæ of ♂ ciliated, with angular projections at joints. Posterior tibial spurs long and nearly equal. Forewings with 4 and 5 coincident, 8, 9, 10 stalked, 11 absent. Hindwings with 5 absent.

The neuration is difficult to make out on the type specimen, but I think this will be found correct.

Elachypteryx erebenna, n. sp.

(*Erebennos*, dark, gloomy.)

♂, 9 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Legs fuscous, tarsi and inferior surface whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen strongly indented at $\frac{1}{3}$ and again near tornus; fuscous mixed with whitish; cilia fuscous, on apex and indentations whitish. Hindwings with termen strongly indented beneath apex; fuscous mixed with whitish; a terminal series of four black spots edged with silvery scales; cilia fuscous, apices whitish.

Type in Coll. Turner.

Q., Brisbane, in May; one specimen.

Genus Nannomorpha, *nov.*

(*Nannomorphos*, dwarfish.)

Face flat. Tongue obsolete. Palpi moderate, ascending; second joint tufted anteriorly; terminal joint moderate, with loose projecting scales. Maxilliary palpi strongly dilated with scales at apex. Antennæ with triangular thickenings at joints towards apex. [Legs broken.] Forewings with veins 4 and 5 stalked, 6 absent, 10 separate. Hindwings normal.

Allied to *Nymphula*, differing in the absence of tongue and neuration of forewings.

Nannomorpha alychnopa, n. sp.

(*Aluchnopos*, without brilliance, dull.)

♀, 11 mm. Head, palpi, thorax, and abdomen fuscous with some whitish scales. Antennæ ochreous-whitish with blackish annulations. Anterior legs ochreous-whitish suf-

fused with fuscous; [middle and posterior pairs broken]. Forewings elongate-triangular, costa nearly straight, apex rounded, termen indented beneath apex, thence obliquely rounded; whitish densely irrorated with fuscous; some pale dots on costa; a transverse dentate pale line at $\frac{1}{4}$, with a dark-fuscous median dot on its posterior edge; a dark-fuscous median discal dot; a second pale transverse line at $\frac{4}{5}$; cilia whitish, a median line and apices fuscous. Hindwings with termen rounded, indented beneath apex; colour and markings as forewings.

Type in Coll. Turner.

Q., Eumundi, near Nambour, in December, one specimen.

Genus Eristena.

Eristena, Warr., A.M.N.H. (6), xvii., p. 150. Hmps., Tr. E.S., 1897, p. 136.

Eristena melanolitha, n. sp.

(*Melanolithos*, black-jewelled.)

♂, 18 mm. Head, palpi, and thorax fuscous. Antennæ, abdomen, and legs ochreous-whitish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; fuscous-whitish with fuscous irroration; a roundish median fuscous spot; a fine fuscous subterminal line; cilia fuscous-whitish. Hindwings with termen rounded; whitish, a fine postmedian fuscous line not reaching costa and dorsum; a similar subterminal line only developed opposite median third of termen, on which are three black dots, intersected by tooth-like processes from this line; cilia whitish.

Type in Coll. Turner.

Q., Stradbroke Island; one specimen.

Genus Bæoptila, *nov.*

(*Baioptilos*, with little wings.)

Frons flat. Tongue well-developed. Labial palpi moderate, cylindrical, slightly ascending; terminal joint long, tolerably acute. Antennal joints triangularly dilated at apex; ciliations in ♂ minute. Forewings with 8 and 9 stalked, 10 separate but closely applied to 8 + 9, 11 absent. Hindwings with 7 anastomosing with 8.

Differs from *Nymphula* in the absence of vein 11 of forewings. It is probably related to *Musotima*, but I should like further material for examination.

Bæoptila selenias, n. sp.

(*Selene*, the moon; in allusion to the crescentic markings.)

♂, 8½ mm. Head, antennæ, thorax, and abdomen fuscous. Palpi whitish with three fuscous annulations. Legs

white. Forewings triangular, costa moderately arched, termen scarcely bowed, oblique, strongly indented at $\frac{1}{4}$ from apex; fuscous; a white spot on costa before middle, continuous with a white crescentic discal mark, its concavity outwards; a white crescentic line from $\frac{3}{4}$ costa to mid-disc, its concavity inwards; a short oblique white subapical streak; a dark-fuscous terminal line interrupted at indentation; cilia whitish, on apex and mid-termen dark-fuscous. Hindwings with termen rounded, indented beneath apex; colour as forewings but without white markings.

This obscure species is one of the smallest of the Pyralidæ.

Type in Coll. Lyell.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

Genus Araeomorpha, *nov.*

(*Araiomorphos*, slenderly formed.)

Frons rounded. Tongue well developed. Palpi upturned, reaching vertex; second joint with loose speading hairs towards base; terminal joint long, slender, acute. Maxillary palpi short, rather stout, not dilated. Antennæ of ♂ simple, shortly ciliated. Legs long and slender; spurs nearly equal. Forewings with 3 and 4 stalked, or less commonly connate; 8, 9, 10 stalked. Hindwings with 4 absent (coincident with 5), 6 and 7 stalked.

The stalking of 3 and 4 of the forewings though characteristic is not always present.

Araeomorpha atmota, n. sp.

(*Atmotos*, smoky.)

♂ ♀, 14-19 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Legs fuscous, beneath whitish. Forewings narrow-elongate, posteriorly dilated, costa gently arched, apex rounded, termen obliquely rounded; pale-fuscous, markings darker fuscous; suffused spots at base of costa and dorsum; similar spots beneath costa at $\frac{1}{4}$ and middle; a pale sigmoid line from $\frac{3}{4}$ costa to mid-dorsum; an indistinct subterminal line; cilia grey, apices whitish. Hindwings with termen rounded; whitish, towards termen greyish; cilia greyish.

The description of *Nymphula diplopa*, Low., resembles this species, but it should be structurally different.

Type in Coll. Turner.

N.Q., Kuranda, in October. Q., Brisbane, from September to April. Abundant on the river bank, resting on plants, etc., at the edge of the water. Probably the larvæ are aquatic.

NYMPHULA ARISTODORA, n. sp.

(*Aristos*, best; *doron*, a gift.)

♂, 10-12 mm. Head whitish. Palpi dark-fuscous; apices whitish. Antennæ ochreous-whitish. Thorax and abdomen whitish mixed with ochreous. Legs whitish annulated with fuscous; anterior pair mostly fuscous. Forewings elongate-triangular, costa scarcely arched, apex rounded, termen obliquely rounded, slightly indented at $\frac{1}{3}$ from costa; white mixed with ochreous and fuscous; costa suffused with fuscous as far as middle; a median fuscous and ochreous fascia from before mid-costa, broadening in disc, to mid-dorsum; beyond this is an ochreous fascia interrupted in middle, giving off below interruption a process towards mid-termen; a fine wavy dark-fuscous line from $\frac{3}{4}$ costa to mid-disc; an ochreous-fuscous subapical costal blotch; a terminal ochreous fascia anteriorly edged with fuscous; cilia whitish with a fuscous basal line. Hindwings with termen strongly indented at $\frac{1}{3}$; a fuscous line from middle of dorsum not reaching costa, preceded by an ochreous suffusion; a dark-fuscous median fascia broadly dilated in disc; followed by a broad ochreous fascia; terminal fascia and cilia as forewings.

Type in Coll. Turner.

Q., Brisbane, in April and May; taken abundantly in one locality on the edge of a waterhole.

NYMPHULA EPIMOCHLA, n. sp.

(*Epimochlos*, marked with a bar.)

♂, 18 mm. Head, palpi, and antennæ ochreous-whitish. Thorax and abdomen pale ochreous-fuscous. Legs ochreous-whitish; anterior pair infuscated. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; vein 10 stalked with 8 + 9; pale ochreous-fuscous mixed with whitish; a fine white subterminal line; cilia ochreous-whitish, bases barred with fuscous. Hindwings with termen rounded; white; a narrow median and broad post-median fuscous fascia; an ochreous-fuscous terminal fascia edged anteriorly with fuscous; cilia ochreous-fuscous with four or five blackish basal dots towards apex of wing.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen. There are also two specimens in the British Museum.

CATACLYSTA PSATHYRODES, n. sp.

(*Psathurodes*, of fragile appearance.)

♂, 12 mm. Head white. Palpi white; basal half of terminal joint fuscous externally. Antennæ grey; in ♂

with angular projections at joints and short ciliations ($\frac{1}{2}$). Thorax fuscous; patagia white. Abdomen white irrorated with fuscous. Legs white; anterior pair fuscous, tarsi white with fuscous annulations. Forewings elongate-triangular, costa gently arched, apex pointed, termen slightly sigmoid, slightly oblique; white, with dark-fuscous and ochreous-brown scales; costal edge fuscous; a short blackish longitudinal streak from base; a blackish line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a triangular ochreous-brown suffusion on dorsum beyond middle, edged above with blackish scales; a fine black circle in disc at $\frac{3}{4}$ connected by ochreous-brown suffusions with costa at $\frac{2}{3}$ and $\frac{5}{6}$, and with tornus; a fuscous terminal line; cilia white with a few fuscous scales. Hindwings with termen rounded, scarcely indented beneath apex; white; irregular blackish suffusions before and beyond middle; a pale ochreous subterminal band; terminal line and cilia as forewings.

Type in Coll. Turner.

Q., Stradbroke Island, in January; one specimen.

Genus Hylebatis, *nov.*

(*Hulebates*, haunting the forest.)

Frons flat. Tongue well-developed. Palpi moderate, porrect, triangularly dilated with hairs, terminal joint concealed. Maxilliary palpi strongly dilated at apices. Antennæ with triangular projections at joints; in ♂ with rather long cilia. Posterior tibiæ with inner median spur long, outer $\frac{1}{2}$, inner distal spur moderate, outer $\frac{2}{3}$. Forewings with 8 and 9 stalked, 10 closely approximated to 8 + 9. Hindwings normal.

Allied to *Nymphula* but with different palpi.

Hylebatis scintillifera, n. sp.

(*Scintillifer*, sparkling.)

♂ ♀, 12-16 mm. Head pale ochreous-fuscous. Palpi whitish; external surface fuscous. Antennæ ochreous-whitish; ciliations in ♂ $1\frac{1}{2}$. Thorax ochreous-whitish. Abdomen pale ochreous-fuscous, apices of segments whitish. Legs ochreous-whitish; anterior tibiæ and tarsi annulated with blackish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen rounded, oblique; whitish suffused and irrorated with ochreous-fuscous; a strongly outwardly-curved fuscous transverse sub-basal line, and a similar slightly curved line at $\frac{1}{3}$; a median fuscous pale-centred discal dot; a third line from $\frac{4}{5}$ costa to termen, then looped to beneath discal dot, where it forms a second loop, ending in dorsum beyond middle, after describing a sharp externally

directed angle near dorsum; the costal portion of this line is bounded by a clear white line on either side; a subapical ochreous-fuscous blotch bounded posteriorly by a white line; a broad streak of metallic brassy scales above tornus; an ochreous-fuscous terminal line; cilia whitish mixed with fuscous, with a dark-fuscous basal line. Hindwings with termen deeply indented beneath apex; colour as forewings; towards costa whitish; a triangular basal darker blotch on dorsum; a median dark line from dorsum not reaching costa; an ochreous line opposite middle third of termen, succeeded by a black line containing several white dots; and this by a terminal line of brilliant brassy metallic scales; cilia as forewings but whitish towards tornus.

Type in Coll. Turner.

Q., Eumundi, near Nambour, and Mount Tambourine, in November, December, and March; common in damp places in the tropical forest growth.

MUSOTIMA LEPTORRHODA, n. sp.

(*Leptorrhodos*, faintly rosy.)

♂ ♀, 10-11 mm. Head, thorax, and abdomen pinkish-white; in ♀ fuscous. Palpi dark-fuscous, annulated with whitish. Antennæ ochreous-whitish; in ♀ fuscous. Legs white. Forewings triangular, costa moderately arched, apex tolerably rectangular, termen deeply indented beneath apex, then rounded, scarcely oblique; pale-pinkish with fuscous transverse lines; in ♀ almost wholly suffused with fuscous; three lines before $\frac{1}{3}$; a linear median discal mark, preceded on costa by a white dot, preceded and followed by a fuscous dot; an incomplete line from $\frac{2}{3}$ dorsum not reaching mid-disc; a fine dentate line at $\frac{5}{6}$, succeeded on costa by a slender triangular white spot; apical area above indentation ochreous, containing a leaden-metallic spot, with a blackish dot on its posterior edge; beneath indentation a subterminal series of blackish dots; cilia fuscous. Hindwings with termen slightly incised beneath apex; colour and markings as forewings, but without costal and apical markings.

Type in Coll. Turner.

N.Q., Kuranda, in May; two specimens received from Mr. F. P. Dodd.

Genus COSMOPHYLLA, *nov.*

(*Kosmophullos*, neat-winged.)

Frons flat. Tongue present. Labial palpi moderate, somewhat up-curved; second joint moderately scaled; terminal joint cylindrical, ascending, obtuse. Maxillary palpi well developed, dilated with scales at apex. Antennal joints tri-

angularly dilated with scales at apices; ciliations in ♂ minute. [Posterior legs broken.] Forewings with 4 and 5 short-stalked, 8 and 9 stalked, 10 separate, but closely applied for some distance to 8+9. Hindwings with 3 from angle, 4 and 5 stalked, 7 anastomosing with 8 nearly to apex.

Cosmophylla oxygramma, n. sp.

(*Oxugrammos*, with sharply-angled markings.)

♂, 21-22 mm. Head white, with two posterior fuscous spots. Palpi pale-fuscous, internal surface white. Antennæ fuscous; in ♂ very minutely ciliated. Thorax white; bases of tegulæ, bases and apices of patagia, and a pair of dorsal spots fuscous. Abdomen grey, irrorated with white, more so towards base and apex. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; white; markings fuscous, tinged with ferruginous; a narrow costal streak to apex; subcostal, median, and dorsal longitudinal streaks from near base, terminating in an oblique bar from beneath $\frac{3}{5}$ costa to $\frac{2}{5}$ dorsum; fine streaks along subcostal veins to costa, but not reaching termen, the latter streaks join at extremities forming very acute dentations; an inwardly-curved fascia from apex, sharply dentate on both margins, broadening beneath to occupy nearly $\frac{1}{2}$ dorsum; a broad terminal line including some white scales; cilia white, faintly barred with fuscous. Hindwings with termen rounded; white; some pale-fuscous scales on veins; a faint fuscous line at $\frac{5}{6}$, another near termen, and a third on termen, all obsolete towards tornus; cilia white.

Type in Coll. Drake.

V., Beaconsfield, in October and December; two specimens, of which one is in my collection.

Voliba leptomorpha, n. sp.

(*Leptomorphos*, slightly-built.)

♀, 11 mm. Head and antennæ ochreous-whitish. Palpi ochreous-whitish, mixed with fuscous. Thorax whitish, anteriorly fuscous-tinged. Abdomen whitish. Legs fuscous, annulated with whitish; posterior pair whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen obliquely rounded; ochreous-whitish; markings fuscous; a basal fascia, expanded on costa; a transverse straight linear fascia at $\frac{1}{3}$; a discal dot beneath $\frac{2}{5}$ costa; a larger discal dot beneath $\frac{3}{5}$ costa; a postmedian line from $\frac{3}{4}$ costa, bent inwards to touch lower extremity of posterior dot, and then to $\frac{2}{3}$ dorsum; from upper bend it gives off a process to tor-

nus ; cilia whitish. Hindwings with termen rounded ; whitish ; a slight pale-fuscous suffusion on mid-termen ; cilia whitish.

Whiter than *V. scoparialis*, the forewings with clearly defined markings and two discal dots, of which the anterior is free.

Type in Coll. Turner.

N.Q., Townsville, in October ; one specimen received from Mr. F. P. Dodd.

Voliba pycnosticta, n. sp.

(*Puknostikios*, thickly-spotted.)

♂, 12 mm. Head, palpi, and antennæ dark-fuscous. Thorax dark-fuscous, posteriorly whitish. Abdomen whitish, posteriorly greyish. Legs fuscous with whitish annulations. Forewings elongate, posteriorly dilated, costa gently arched, apex rounded, termen obliquely rounded ; whitish, markings fuscous, suffused ; a basal patch ; a transverse fascia at $\frac{1}{4}$; another in middle, dilated on costa ; a spot on costa at $\frac{3}{4}$, giving rise to a dentate line to tornus ; some fuscous suffusion on termen ; cilia grey-whitish. Hindwings ovate-lanceolate ; whitish, with some grey suffusion ; cilia whitish.

The head and markings on forewings are darker than in *V. scoparialis*, and the latter are conspicuously dilated on costa.

Type in Coll. Turner.

Q., Burpengary, near Brisbane, in April ; one specimen.

Voliba asphyctopa, n. sp.

(*Asphuktopos*, feeble-looking.)

♂, 10 mm. Head and antennæ ochreous-whitish. Palpi ochreous-whitish, mixed with fuscous. Thorax and abdomen whitish. Legs whitish ; anterior, tibiæ, and tarsi fuscous, with whitish annulations. Forewings narrow-elongate, slightly dilated posteriorly, costa slightly arched, apex rounded, termen obliquely rounded ; whitish ; markings fuscous, distinct ; an obscure basal patch ; a narrow transverse fascia at $\frac{1}{3}$, succeeded by a subcostal dot ; a larger discal dot at $\frac{2}{3}$; a fine dentate line from $\frac{3}{4}$ costa, bent inwards to touch discal dot, then curved in a right angle to $\frac{4}{5}$ dorsum ; a dot above tornus close to termen ; cilia whitish. Hindwings ovate-lanceolate ; whitish ; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in October ; one specimen received from Mr. F. P. Dodd.

Voliba psammoessa, n. sp.

(*Psammoeis*, sandy.)

♂, 12-13 mm. Head, thorax, palpi, and antennæ pale ochreous-fuscous. Abdomen whitish, bases of segments dark-fuscous, tuft pale-ochreous. Legs ochreous-whitish, annulated with fuscous; anterior pair fuscous, annulated with ochreous-whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen very obliquely rounded; whitish, finely irrorated with ochreous-fuscous; markings dark-fuscous; a dot on base of costa, a fine transverse fascia at $\frac{1}{4}$; a pale-centred discal ring beyond middle, connected by a fine dentate line with $\frac{4}{5}$ dorsum; a line from $\frac{3}{4}$ costa, at first straight, then describing a small outward curve, and ending above tornus; a fine terminal line not reaching tornus; cilia ochreous-whitish. Hindwings ovate; whitish; towards apex a pale-fuscous suffusion, containing an obscure fuscous line; a short dark-fuscous streak from tornus; cilia whitish.

Type in Coll. Turner.

Q., Adavale, in April; two specimens.

Entephria cissophora, n. sp.

(*Kissophoros*, wearing ivy.)

♂, 18-21 mm. Head white, crown greenish-tinged. Palpi and antennæ whitish. Thorax whitish. Abdomen grey, apices of segments whitish, tuft pale-ochreous. Legs white. Forewings elongate-triangular, costa straight, except near base and apex, apex rounded, termen nearly straight, oblique; grey with purplish reflections, semi-translucent; a large triangular pale-green blotch, extending on costa from $\frac{1}{6}$ to middle, its apex above $\frac{1}{3}$ dorsum, anterior margin straight, posterior straight to lower margin of cell, then strongly waved to apex of blotch; two small oblong pale-green blotches on costa, between this and apex, and a similar streak broad at apex and narrowing on termen, sometimes interrupted, not reaching tornus; cilia white, bases grey. Hindwings with termen rounded; whitish-grey, darker towards mid-termen; cilia as forewings, but wholly white towards tornus and on dorsum.

In the form of the palpi and the elongate genital tuft of the ♂ this species corresponds closely with *Entephria meritalis*, Wlk.

Type in Coll. Turner.

N.Q., Kuranda and Townsville, in January; three specimens received from Mr. F. P. Dodd.

Nacoleia glageropa, n. sp.

(*Glageropos*, milky-looking.)

♂, 22 mm. Head white. Palpi fuscous, base, anterior, and internal surfaces white. Antennæ fuscous; in ♂ thickened and broadly laminate, slightly thicker and obtusely angled in middle, angled again at $\frac{3}{4}$ with a tuft of scales on angle. Thorax and abdomen fuscous, mixed with white. Legs white, annulated with pale-fuscous; anterior pair fuscous, annulated with whitish. Forewings elongate-triangular, costa slightly concave in basal $\frac{2}{3}$, convex in terminal third, apex round-pointed, termen bowed, oblique; fuscous mixed with white, which forms ill-defined blotches near base, on subcostal area, and at tornus; lines fuscous; an outwardly-curved line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; a white discal spot before middle confluent with subcostal suffusion; a line from $\frac{3}{4}$ costa towards tornus, abruptly bent inwards above tornus, and then downwards to $\frac{2}{3}$ dorsum; cilia fuscous, at tornus whitish. Hindwings with termen slightly sinuate; fuscous; whitish towards base, and beneath basal $\frac{2}{3}$ of costa; fuscous lines lost in ground-colour, but edged posteriorly with white; cilia pale-fuscous, towards tornus white, with a darker basal line.

Also allied to *N. rhoeonalis*, but readily distinguished by the whitish blotches.

Type in Coll. Turner.

N.Q., Kuranda, in September; one specimen received from Mr. F. P. Dodd.

Nacoleia oncophragma, n. sp.

(*Onkophragmos*, with bent margin.)

♂ ♀, 22-25 mm. Head and thorax fuscous, with some whitish scales. Palpi fuscous, internal surface and base white. Antennæ fuscous; in ♂ thickened and broadly laminate, slightly thicker and obtusely angled in middle, angled again at $\frac{3}{4}$, with a tuft of scales on angle. Abdomen fuscous, with some white scales on terminal segments. Legs white, with pale-fuscous annulations. Forewings elongate-triangular, costa with basal $\frac{2}{3}$ slightly concave, terminal third strongly convex, apex round-pointed, termen sinuate, oblique; fuscous, tinged with ochreous, more so on costa; lines darker-fuscous, obscure; a transverse line at $\frac{1}{4}$; a square pale-ochreous subcostal spot before middle; a finely dentate line from $\frac{4}{5}$ costa towards tornus, abruptly bent inwards above tornus, and again downwards to $\frac{2}{3}$ dorsum; cilia fuscous, on tornus ochreous-whitish. Hindwings with termen sinuate; fuscous, towards base sometimes whitish; an outwardly-curved fuscous

line from $\frac{1}{3}$ costa to $\frac{3}{4}$ dorsum; a finely dentate line from $\frac{2}{3}$ costa not reaching dorsum; cilia whitish, with a fuscous basal line, absent towards costa.

Closely allied to *N. rhoconalis*, Wlk. (=*murcalis*, Wlk.), from which it differs in the strongly sinuate costa of forewings, the more ochreous coloration, absence of second discal spot, and absence of lines in cilia of forewings.

Type in Coll. Turner.

Q., Brisbane, Killarney, and Bunya Mountains, in October and December; three specimens.

Nacoleia alincia, n. sp.

(*Alinkios*, similar.)

♂ ♀, 20 mm. Head fuscous, mixed with whitish. Palpi fuscous, basal half sharply whitish. Antennæ fuscous; in ♂ with moderate ciliations (1), bent beyond middle, and with a small posterior tuft of hairs immediately before bend. Thorax fuscous, with a few whitish scales. Abdomen fuscous, with a broad whitish basal band. Legs whitish, barred with fuscous. Forewings triangular, costa slightly sinuate, apex rounded, termen slightly rounded, oblique; vein 10 separate; whitish generally suffused with fuscous, especially towards costa; a fuscous fascia near base, succeeded by a fine transverse line at $\frac{1}{5}$; fuscous dots in disc at $\frac{1}{3}$ and middle; two fuscous dots on apical $\frac{1}{4}$ of costa, from the second proceeds an inwardly oblique, slightly dentate line, strongly bent outwards in disc, and again inwards, ending on $\frac{2}{3}$ dorsum; cilia fuscous, with a darker basal line. Hindwings as forewings, but without basal lines, and with only one discal spot, postmedian line interrupted in middle.

Very closely allied to *N. amphidecalis*, but forewings without clear whitish median band, and cilia not barred with whitish.

Type in Coll. Turner.

N.Q., Townsville, in January: two specimens received from Mr. F. P. Dodd.

Genus Glycythyma, *nov.*

(*Glukuthumos*, delightful.)

Frons rounded. Tongue well developed. Palpi moderate, upturned, not reaching vertex; second joint moderate, terminal joint short, slender, acute. Maxillary palpi minute, not dilated. Antennæ in ♂ minutely ciliated, not thickened, not bent, not tufted. Tibiæ with outer spurs about $\frac{1}{2}$ length of inner. Forewings with 7 well separated from 8, 9, to which 10 is approximated. Hindwings normal.

Allied to *Nacoleia*, Wlk., from which it is distinguished by the simple antennæ of the ♂, and the more slender and acute terminal joint of the palpi.

Type *Semioceros chrysorycta*, Meyr.

Glycythyma chrysorycta.

Semioceros chrysorycta, Meyr., Tr. E.S., 1884, p. 320.

N.Q., Dank Island and Townsville, in January. Q., Duaringa, Brisbane, in March.

Glycythyma thymedes, n. sp.

(*Thumedes*, well-pleasing.)

♂ ♀. Head and thorax yellow. Palpi yellow, apex fuscous. Antennæ ochreous-fuscous. Abdomen ochreous-yellow. Legs whitish-ochreous. Forewings elongate-triangular, costa straight, apex rounded, termen bowed, oblique; yellow; markings dark-fuscous, clearly defined; a line from costa near base, not reaching dorsum; a line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, curved outwards in middle; a dot beneath $\frac{1}{3}$ costa, sometimes absent; a second reniform costal dot beyond middle, sometimes yellow-centred; a line from $\frac{4}{5}$ costa, describing a sigmoid curve more or less strongly, and touching or nearly so lower end of reniform spot, ending on $\frac{2}{3}$ dorsum; a terminal line, thickened into a triangular spot above middle; cilia fuscous, sometimes barred with whitish. Hindwings with termen rounded; yellow; a fuscous line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, sometimes interrupted in disc; a fuscous suffusion at apex; cilia as forewings.

Readily distinguished from the preceding by the presence of only a single line on hindwings.

Type in Coll. Turner.

N.Q., Townsville, in April; two specimens.

Genus Eurybela, *nov.*

(*Eurubelos*, with broad weapons, *i.e.*, palpi.)

Frons rounded. Tongue well developed. Palpi rather large, curved upwards, not reaching vertex; second joint covered with dense long hairs, forming an anteriorly directed dense tuft at apex; terminal joint short, concealed in hairs of second joint. Maxillary palpi well developed, not dilated at apex. Antennæ in ♂ minutely ciliated. Outer tarsal spurs half inner. Forewings with 3, 4, 5, approximated at base, 7 straight and well separated from 8, 9, to which 10 is closely approximated. Hindwings with 3, 4, 5, approximated at base, 6, 7 stalked, 7 anastomosing with 8.

Characterized mainly by the palpi, which do not appear to correspond to any described genus.

EURYBELA SCOTOPIS, n. sp.

(*Skotopis*, dark-looking.)

♂, 25 mm. Head, palpi, antennæ, thorax, and abdomen dark-fuscous. Legs fuscous, annulated with whitish. Forewings elongate-triangular, costa nearly straight except towards apex, apex rounded, termen bowed, oblique; fuscous, mixed with ochreous-whitish; markings dark-fuscous; an outwardly-curved, somewhat suffused, transverse line at $\frac{1}{3}$; a pale-centred discal spot beneath mid-costa; a dentate line from $\frac{4}{5}$ costa towards tornus, posteriorly edged with ochreous-whitish, above tornus abruptly bent inwards, and then continued to $\frac{2}{3}$ dorsum; cilia fuscous, with a basal series of whitish spots. Hindwings with termen rounded; fuscous; an indistinct darker line, its median portion finely dentate and produced to near termen; cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in May; two specimens received from Mr. F. P. Dodd.

SYLEPTA CHRYSAMPYX, n. sp.

(*Krusampux*, with frontlet of gold.)

♀, 23 mm. Head orange-ochreous; face fuscous. Palpi with terminal joint very small; orange-ochreous, some fuscous scales on anterior and posterior edge. Antennæ grey. Thorax slaty-grey. Abdomen slaty-grey; tuft ochreous. Legs ochreous; anterior coxæ, apices of femora, and tibiæ, and terminal tarsal joints grey. Forewings elongate-triangular, costa straight to near apex, there strongly bowed, apex rounded, termen bowed, oblique; slaty-grey; a transversely elongate, oval, whitish spot on costa at $\frac{4}{5}$; cilia slaty-grey. Hindwings with termen gently rounded; slaty-grey; cilia concolorous.

Type in Coll. Lyell.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

SYLEPTA AGENETA, n. sp.

(*Agenetos*, low-born, plebeian.)

♀, 24 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-fuscous. Legs whitish; anterior pair fuscous. Forewings triangular, costa straight, apical fourth moderately arched, apex round-pointed, termen bowed, oblique; ochreous-fuscous; lines fuscous, obscure; a transverse line at $\frac{1}{5}$; a faint linear discal dot before middle; a line from $\frac{2}{3}$ costa, at first straight and parallel to termen, then bent outwards at a right angle in mid-disc, then parallel to termen for a short distance, again bent rectangularly, first inwards, and then outwards to end on $\frac{2}{5}$ dorsum; cilia fuscous. Hindwings with

termen rounded; fuscous, with an ochreous tinge; a post-median fuscous line produced towards termen in mid-third, forming an obtuse process like that of forewing; cilia fuscous.

Type in Coll. Turner.

N.Q., Cardwell, in August; one specimen.

SYLEPTA PHRICOSTICHA, n. sp.

(*Phrikostichos*, with rippled lines.)

♂ ♀, 32 mm. Head, palpi, antennæ, thorax, and abdomen brown; thorax sometimes reddish-brown; antennal ciliations in ♂ $\frac{2}{3}$. Legs brown-whitish; posterior tibiæ with outer spurs less than $\frac{1}{2}$ inner; posterior femora and tibiæ in ♂ densely fringed with long hairs on upper surface. Forewings triangular, costa straight for $\frac{2}{3}$, then moderately arched, apex acute, termen slightly sinuate, oblique; brown, sometimes reddish-brown; markings fuscous; an obscure slender transverse line at $\frac{1}{6}$; a subcostal dot at $\frac{1}{3}$; and two dots placed transversely beneath mid-costa; a slender acutely dentate line from $\frac{3}{4}$ costa across disc, below middle bent abruptly inwards to beneath median dots, and then downwards to dorsum just beyond middle; a terminal series of minute dots on veins; cilia whitish, bases fuscous. Hindwings with termen rounded; colour as forewings, but paler towards base; one or two dots representing basal line: an acutely dentate postmedian line, its median third produced towards termen; terminal dots and cilia as forewings. Underside pale-brownish, postmedian fuscous, dentate line very distinct, subcostal fuscous dots at $\frac{1}{4}$, that on hindwing larger, with a smaller dot between it and base.

Type in Coll. Turner.

Q., Brisbane; two specimens.

PAGYDA CALLIPONA, n. sp.

(*Kalliponos*, beautifully wrought.)

♂ ♀. 18-20 mm. Head whitish. Palpi whitish, mixed with fuscous and ochreous. Antennæ ochreous-whitish. Thorax whitish, mixed with ochreous. Abdomen ochreous; apices of segments whitish. Legs whitish. Forewings elongate-triangular, costa straight for $\frac{3}{4}$, then gently arched, apex round-pointed, termen sinuate, oblique; ochreous-orange, with three whitish-ochreous fasciæ: first linear from $\frac{1}{6}$ costa to $\frac{1}{4}$ dorsum: second broad from $\frac{1}{3}$ costa, narrowing in disc, not reaching dorsum; third also incomplete, broad, from costa beyond middle, dilated in disc; a fine whitish interrupted line from $\frac{3}{4}$ costa, describing a sigmoid curve to $\frac{3}{4}$ dorsum; a second similar line from costa between this and apex to mid-termen, and continued along termen to tornus; cilia whitish.

Hindwings with termen rounded, slightly sinuate beneath apex; whitish-ochreous, thinly scaled, and partly translucent; an orange-ochreous, outwardly-curved fascia, edged with fuscous and constricted in middle at $\frac{1}{3}$; a similar fascia at $\frac{2}{3}$, broadly interrupted in middle; an orange-ochreous terminal suffusion confluent with second fascia towards tornus: a subterminal line of whitish dots from costa joining a similar terminal line before middle; cilia whitish, mixed with orange-ochreous.

Type in Coll. Turner.

N.Q., Kuranda, in September and December; two specimens received from Mr. F. P. Dodd.

Agathodes paliscia, n. sp.

(*Paliskios*, dusky.)

♂ ♀, 28-34 mm. Head, palpi, and antennæ ochreous-grey. Thorax grey, with purple reflections; a small posterior crest of brownish-fuscous scales. Abdomen whitish suffused with grey; tuft in ♂ dark-grey. Legs white. Forewings narrow-elongate, gradually dilated posteriorly; costa straight to near apex, then arched, apex rounded, termen obliquely rounded, dorsum slightly sinuate; pale-grey, with purple reflections, and some dark-ochreous irroration, especially towards dorsum; a pale linear discal mark at $\frac{2}{3}$, succeeded by a dark-ochreous suffusion; a pale line from $\frac{5}{6}$ costa obliquely outwards nearly to termen, then bent and finely dentate to $\frac{3}{4}$ dorsum; disc beyond this dark-ochreous; a fine white interrupted terminal line; cilia dark-ochreous. Hindwings more than twice breadth of forewings, termen scarcely rounded, in ♀ sinuate beneath apex: thin-scaled and semi-translucent, pale-grey, towards base whitish; cilia white, with a grey basal line.

Type in Coll. Turner.

N.Q., Townsville, in February; two specimens received from Mr. F. P. Dodd.

Pygospila hyalotypa, n. sp.

(*Hualotupos*, with transparent markings.)

♂, 46 mm. Head grey; sides of face whitish. Palpi with second joint very broad, rounded anteriorly; grey; base of second joint sharply whitish. Antennæ grey. Thorax grey with some whitish scales. Abdomen grey. Legs whitish; tibiæ and tarsi annulated with pale-grey. Forewings triangular, costa straight to near apex, there strongly bowed, apex rounded, termen slightly bowed, oblique, dorsum sinuate; fuscous-grey, with purple lustre; spots translucent, free from

scales: a dot below cell near base, and another in cell towards base: a quadrangular spot in cell at $\frac{1}{3}$, and another oval spot on dorsal side of it below cell; a quadrangular spot beneath $\frac{2}{3}$ costa, bisected by vein 6: a smaller spot obliquely below this bisected by vein 4; cilia fuscous. Hindwings with termen sinuate; vein 8 in ♂ bowed and clothed beneath with long scales; colour and cilia as forewings; one translucent spot only, towards base on dorsal side of cell, elongate-ovoid, narrower towards base.

Type in Coll. Lyell.

N.Q., Kuranda; one specimen, received from Mr. F. P. Dodd. Mulgrave River, near Cairns, in December; one specimen.

Archernis eucosma, n. sp.

(*Eukosmos*, well-adorned.)

♂ ♀, 31-32 mm. Head pale-grey, face white except for a pale-grey superior spot. Palpi fuscous, inner-surface and base white. Antennæ pale-grey. Thorax and abdomen pale-grey. Legs white; anterior femora and distal $\frac{2}{3}$ of tibiæ dark-fuscous on internal surface. Forewings triangular, costa straight for $\frac{3}{4}$, then rather strongly arched, apex rounded, termen bowed, oblique; pale-grey; a blackish crescentic median discal spot; a fine fuscous line from $\frac{3}{4}$ costa, wavy, outwardly curved, towards dorsum bent inwards, and then downwards to $\frac{3}{4}$ dorsum; an elongate suffused white spot on posterior edge of this line beneath costa, and a smaller similar spot above dorsum; cilia whitish barred with fuscous. Hindwings with termen rounded; pale-grey; discal spot rather large, blackish, angular; a postmedian fuscous line bent outwards towards termen in middle third; a fuscous terminal line; cilia white, bases barred with fuscous.

Type in Coll. Turner.

N.Q., Townsville, in February; two specimens received from Mr. F. P. Dodd.

Archernis leucocosma, n. sp.

(*Leukokosmos*, with white ornament.)

♂ ♀, 22-26 mm. Head greyish-brown, face white. Palpi $3\frac{1}{2}$; fuscous-brown, base white. Antennæ greyish-brown. Thorax and abdomen greyish-brown. Legs white; anterior femora and tibiæ fuscous on internal surface. Forewings triangular, costa straight for $\frac{3}{4}$, then arched, apex round-pointed, termen bowed, oblique; greyish-brown; a fine fuscous transverse line at $\frac{1}{3}$; a snow-white median discal spot, edged

anteriorly with fuscous; a fine fuscous wavy line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, edged posteriorly with white in costal portion; cilia fuscous, apices white except opposite mid-termen. Hindwings with termen rounded; greyish-brown; a snow-white discal spot edged anteriorly with fuscous; a fuscous post-median line, edged posteriorly with white throughout, and produced towards termen in middle; cilia white with a basal fuscous line.

Type in Coll. Turner.

N.Q., Kuranda, in October and May; two specimens received from Mr. F. P. Dodd.

ARCHERNIS METRIODES, n. sp.

(*Metriodes*, of ordinary appearance.)

♂, 29 mm. Head pale-brown, face white. Palpi 2; fuscous-brown, base white. Antennæ pale-brown. Thorax and abdomen pale-brown. Legs white; internal surface and anterior femora and tibiæ fuscous. Forewings triangular, costa straight for $\frac{3}{4}$, then arched, apex round-pointed, termen bowed, oblique; pale-brown; basal line obsolete; a linear crescentic fuscous median discal mark; a fine wavy fuscous line from $\frac{2}{3}$ costa towards tornus, abruptly bent inwards in disc and then downwards to $\frac{3}{5}$ dorsum; cilia brown-whitish with a fuscous basal line. Hindwings with termen rounded; as forewings but discal mark straight, postmedian line with middle third produced towards termen and dentate.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

METASIA POLYTIMA, n. sp.

(*Polutimos*, much-esteemed.)

♂, 14-15 mm. Head ochreous-whitish, face fuscous. Palpi 3; fuscous, beneath white. Antennæ whitish with incomplete fuscous annulations; ciliations in ♂ $\frac{2}{3}$. Thorax pale-reddish. Abdomen pale-reddish; apical segments fuscous. Legs whitish with some fuscous suffusion; anterior pair mostly fuscous. Forewings triangular, costa straight, slightly indented at $\frac{2}{3}$ and thence gently arched, apex rounded, termen bowed, oblique; pale-reddish; a broad dark-fuscous costal streak to $\frac{2}{3}$; a fine fuscous transverse line at $\frac{1}{3}$; a pale discal spot outlined with fuscous and connected by a fine fuscous line with dorsum beyond middle; a wavy dark-fuscous line from $\frac{3}{4}$ costa to before tornus; disc beyond this suffused with fuscous; a dark-fuscous terminal line; cilia fuscous with

whitish bases and a darker median line. Hindwings with termen rounded, distinctly indented towards apex; colour, antemedian, postmedian and terminal lines, and cilia as forewings.

Type in Coll. Turner.

N.Q., Townsville, in September; two specimens.

Metasia dactyliota, n. sp.

(*Daktuliotos*, ringed; in allusion to discal spot of forewings.)

♀, 16 mm. Head and antennæ pale-fuscous. Palpi $1\frac{3}{4}$; fuscous-whitish. Thorax ochreous-whitish mixed with fuscous. Abdomen whitish, bases of segments broadly fuscous. Legs fuscous annulated with whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen bowed, oblique; ochreous-whitish irrorated with fuscous; markings fuscous; a broadly suffused sub-basal line; an irregularly dentate transverse line at $\frac{1}{5}$; a similar line from mid-costa to $\frac{2}{3}$ termen, bifurcating to enclose a small whitish discal spot; a third similar line from $\frac{2}{3}$ costa to tornus; two fuscous dots on costa between this and apex; a fuscous terminal line; cilia whitish, bases ochreous-whitish mixed with pale-fuscous. Hindwings with termen rounded; whitish with some fuscous irroration; a fuscous transverse line from tornus, lost in mid-disc; a similar incomplete line from termen beyond tornus; an apical fuscous suffusion; cilia as forewings, but at tornus wholly whitish.

Type in Coll. Turner.

N.Q., Townsville, in August; one specimen received from Mr. F. P. Dodd.

Metasia diplophragma, n. sp.

(*Diplophragmos*, with double margin.)

♀, 14 mm. Head white. Palpi $3\frac{1}{2}$; external surface pale-fuscous. Antennæ grey. Thorax whitish-ochreous. Abdomen whitish-ochreous, bases of segments fuscous. Legs whitish-ochreous; apices of anterior tibiæ fuscous. Forewings elongate-triangular, costa nearly straight, apex rounded, termen bowed, strongly oblique; whitish-ochreous; markings fuscous, distinct; some fuscous suffusion at base; an outwardly curved line from $\frac{1}{4}$ costa to $\frac{2}{5}$ termen; an obliquely elongate median discal spot; a sinuate line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, succeeded by some fuscous irroration; a fuscous terminal line; cilia whitish with a fuscous basal line. Hindwings with termen slightly sinuate; colour, terminal line, and cilia as forewings; broadly

suffused fuscous lines at $\frac{1}{3}$ and before termen, the latter not reaching dorsum, both not reaching costa.

Type in Coll. Turner.

N.Q., Townsville, in November; one specimen received from Mr. F. P. Dodd.

METASIA NYCTICHROA, n. sp.

(*Nuktichroos*, dusky.)

♂, 14 mm. Head fuscous. Palpi $2\frac{1}{4}$; fuscous, whitish beneath. Antennæ fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax and abdomen fuscous. Legs whitish-ochreous; anterior pair mostly fuscous. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; ochreous-whitish densely irrorated with fuscous; markings obscure; a pale oblong spot in disc at $\frac{2}{3}$: an ill-defined line from $\frac{3}{4}$ costa towards tornus, bent inwards above tornus and again downwards to $\frac{2}{3}$ dorsum; cilia whitish mixed with fuscous. Hindwings with termen sinuate; pale-ochreous with fuscous irroration; a short line from $\frac{2}{3}$ dorsum not reaching mid-disc; cilia as forewings.

Type in Coll. Turner

Q., Killarney, in October; one specimen.

METASIA TYPHODES, n. sp.

(*Tuphodes*, smoky.)

♂, 16 mm. Head ochreous. Palpi $2\frac{1}{4}$; ochreous. Antennæ fuscous; ciliations in ♂ extremely short. Thorax and abdomen fuscous. Legs whitish. Forewings triangular, costa slightly arched, apex round-pointed, termen bowed, oblique; fuscous with darker lines; a straight transverse line at $\frac{1}{4}$; a minute dark median discal dot; a line from $\frac{3}{4}$ costa towards tornus, bent inwards in disc and again downwards to $\frac{2}{3}$ dorsum; cilia fuscous. Hindwings with termen rounded; colour as forewings; a single transverse darker line from tornus to $\frac{2}{3}$ costa.

The yellowish head contrasting with the uniformly dusky wings should be sufficient for the recognition of this species.

Type in Coll. Turner.

Q., Brisbane and Toowoomba; two specimens.

METASIA ADOXODES, n. sp.

(*Adoxodes*, obscure.)

♂, 15 mm. Head fuscous with white irroration; face fuscous. Palpi 2; fuscous, base partly white. Antennæ fuscous; ciliations in ♂ extremely short. Thorax white with dense fuscous irroration. Abdomen grey, at base ochreous-tinged. Legs white; anterior and middle pairs with dense

fuscous irroration. Forewings elongate-triangular, costa slightly arched, apex rounded, termen slightly bowed, oblique; white, densely irrorated with fuscous throughout; markings dark-fuscous; a dot near base; a transverse line at $\frac{1}{6}$; a subcostal dot at $\frac{1}{3}$; a transverse linear median discal mark; a line from $\frac{5}{6}$ costa towards tornus, bent inwards in mid-disc to beneath discal mark, and then downwards to $\frac{3}{4}$ dorsum; a suffused terminal line; cilia whitish with a fuscous line near bases. Hindwings with termen rounded; grey, towards base paler; cilia whitish with a grey basal line.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen.

METASIA TROPHŒSSA, n. sp.

(*Trophoeis*, stout, large.)

♂, 22 mm. Head ochreous-whitish; face fuscous. Palpi $1\frac{1}{2}$; fuscous, base whitish. Antennæ pale-fuscous; in ♂ with moderately long ciliations ($1\frac{1}{2}$). Thorax fuscous. Abdomen whitish-ochreous with a few fuscous scales; three terminal segments dark-fuscous on dorsum. Legs dark-fuscous annulated with whitish. Forewings elongate-triangular, costa straight for $\frac{3}{4}$, then moderately arched; apex round-pointed, termen bowed, oblique; ochreous-whitish with much fuscous irroration; markings fuscous, suffused; a transverse line near base and another at $\frac{1}{4}$; a median discal spot; a line from $\frac{4}{5}$ costa towards tornus, bent inwards beneath discal spot, and again downwards to $\frac{3}{4}$ dorsum; a terminal series of dots; cilia grey with a darker basal line. Hindwings with termen rounded; ochreous-yellow; a broad dark-fuscous terminal band, broadest on costa, narrowing to tornus; cilia as forewings.

Type in Coll. Turner.

Q., Toowoomba, in April; one specimen.

ISOCENTRIS ERROMENA, n. sp.

(*Erromenos*, stout.)

♂, 39 mm. Head orange-ochreous. Palpi dark-fuscous; base and a broad median ring ochreous. Antennæ dark-fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax dark-fuscous; tegulæ and a posterior spot orange-ochreous. Abdomen ochreous; bases of first, second, sixth, and seventh segments, and whole of eighth segment except apex dark-fuscous. Legs dark-fuscous; inner half of anterior coxæ ochreous. Forewings triangular, costa sinuate, apex rounded, termen bowed, oblique; dark-fuscous, markings orange-ochreous; a small spot at base of costa, and another on mid-base; a large quad-

rangular spot before middle, larger towards dorsum, unequally divided by a fine fuscous line on median vein; a rounded spot at $\frac{2}{3}$, nearer costa than dorsum; cilia fuscous, apices pale-ochreous. Hindwings with termen rounded, slightly sinuate; orange-ochreous; an antemedian spot and a broad terminal band dark-fuscous; cilia as forewings.

Type in Coll. Lyell.

N.Q., Cooktown (?); one specimen.

Genus Cœlobathra, *nov.*

(*Koilobathros*, with hollowed base.)

Head with slight rounded prominence. Palpi porrect; second joint slightly ascending, terminal joint bent forward, well developed. Maxillary palpi filiform. Antennæ of ♂ minutely ciliated. Posterior tibiæ of ♂ with outer middle spur rudimentary, outer end-spur $\frac{1}{2}$ inner. Forewings of ♂ with large fovea on upper surface near base, frenulum and retinaculum well developed, costal portion of hindwings expanded near base to cover under-surface of fovea; vein 10 separate. Hindwings with 5 approximated at base to 4, 7 anastomosing with 8 to near apex.

A peculiar genus. The partial obsolescence of posterior tibial spurs recalls *Phlyctœnia*, but the long anastomosis of vein 7 of hindwings, together with the fovea on forewings of ♂, remove it from that genus.

Cœlobathra eucrines.

(*Eukrines*, clear, distinct.)

♂, 13 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-yellow. Legs whitish-ochreous. Forewings triangular, costa nearly straight, apex rounded, termen bowed oblique; bright ochreous-yellow; markings blackish; a dot beneath $\frac{1}{3}$ costa, another on $\frac{1}{3}$ dorsum, and a third between and slightly anterior to these, on edge of fovea; a discal dot at $\frac{2}{3}$; posterior line distinct, from $\frac{5}{6}$ costa, bent first outwards, then strongly inwards to beneath discal dot, and rectangularly to $\frac{2}{3}$ dorsum; [cilia abraded]. Hindwings with termen rounded; grey; paler towards base; cilia whitish-ochreous.

Type (somewhat worn) in Coll. Lyell.

N.A., Port Darwin, in March; one specimen.

Pyrausta diplosticta, n. sp.

(*Diplostiktos*, doubly-spotted.)

♀, 22-26 mm. Head, palpi, antennæ, thorax, and abdomen brownish-grey. Legs whitish; anterior pair grey. Forewings triangular, costa straight, terminal fourth rounded,

apex round-pointed, termen bowed, oblique; pale brownish-grey; a clear white median subcostal spot, edged with some darker scales; a similar spot narrower and twice constricted at $\frac{3}{4}$; cilia grey. Hindwings with termen rounded, slightly sinuate; median vein with a few loose hairs; ochreous-whitish with some brownish-grey irroration; an antemedian dot, and a subterminal band of the same colour; cilia grey.

Type in Coll. Lyell.

V., Lorne, in December and March; three specimens received from Mr. G. Lyell.

PYRAUSTA APOCRYPHA, n. sp.

(*Apokruphos*, hidden, obscure.)

♀, 32 mm. Head pale-brownish. Palpi $1\frac{1}{2}$; pale-brownish, base white. Antennæ whitish. Thorax pale-brownish. Abdomen brown-whitish. Legs whitish. Forewings rather elongate-triangular, costa straight for $\frac{2}{3}$, then arched, apex round-pointed, termen scarcely bowed, oblique; pale-brownish without markings, except traces of a suffused, slightly darker, oblique, postmedian line; cilia brown-whitish. Hindwings with termen rounded; brown-whitish; a very indistinct, suffused, postmedian line; cilia whitish.

Type in Coll. Turner.

Q., Brisbane, in March; one specimen.

Genus OTIOPHORA, *nov.*

(*Otiophoros*, bearing little ears; in allusion to fovea on forewing.)

Head flat and oblique. Tongue well developed. Palpi moderate, porrect; terminal joint short, obtuse. Maxillary palpi well-developed, not dilated. Antennæ in ♂ minutely ciliated. Posterior tibiæ with outer spurs $\frac{1}{2}$ inner. Forewing of ♂ with a large auricular fovea near base on upper surface between subcostal vein and dorsum, bounded dorsally by a steep ridge; vein 10 separate. Hindwings with vein 7 anastomosing with 8 to nearly apex.

Type *Pionea leucura*, Low.

OTIOPHORA LEUCURA.

Pionea leucura, Low., Tr. R.S.S.A., 1903, p. 67.

This species is not "white-tailed," as the name would imply.

N.Q., Townsville. Q., Brisbane.

Otiophora clavifera.

Pionea clavifera, Hmps., P.Z.S., 1889, p. 241.

N.Q., Kuranda, Townsville (Dodd).

Genus Noorda.

In this genus, as I understand it, vein 10 may be either separate or stalked with 8+9. It includes the species referred by Sir Geo. Hampson to *Clupeosoma* and *Hemiscopis*. In fact, *N. polalis (polusalis)*, Wlk., is specifically closely allied to *N. suffusalis*, Wlk., and to *nyctopa*, described below. The genus is a very natural one, characterised by the form of the labial and maxillary palpi.

Noorda nyctopa, n. sp.

(*Nuktopos*, dark, gloomy.)

♂ ♀, 18-22 mm. Head ochreous-fuscous. Palpi 4; fuscous. Antennæ fuscous; ciliations in ♂ minute. Thorax fuscous. Abdomen fuscous, posteriorly fuscous-whitish. Legs ochreous-whitish; anterior femora and middle tibiæ fuscous; anterior tibiæ and tarsi white. Forewings triangular, costa at first straight, then rather strongly arched, apex rounded, termen bowed, oblique; 10 separate; fuscous with a dull-purple lustre; an ochreous-fuscous line, slightly outwardly-curved, at $\frac{1}{5}$; a similar but broader line; its anterior edge suffused, from $\frac{3}{5}$ costa obliquely outwards, obtusely bent beneath costa and curved inwards to $\frac{3}{5}$ dorsum; terminal area fuscous-whitish; a fuscous terminal line; cilia fuscous. Hindwings with termen rounded; fuscous-whitish; median area fuscous-purple, crossed by an ochreous-fuscous postmedian line, which is more obscurely continued to tornus; a fuscous terminal line; cilia fuscous, on costa, tornus, and dorsum fuscous-whitish.

Pyrausta violacea, Luc. (P.L.S.N.S.W., 1892, p. 263), may be based on a confusion of this species with the allied *suffusalis*, Wlk., but the description plainly applies to the latter.

Type in Coll. Turner.

Q., Sandgate, near Brisbane; Southport; from October to February; the larvæ abundant on *Wikstroemia indica*.

Noorda rhodopa, n. sp.

(*Rhodopos*, rosy.)

♀, 20 mm. Head whitish-ochreous. Palpi 4; whitish-ochreous mixed with fuscous. [Antennæ broken.] Thorax pale-rosy. Abdomen whitish-ochreous. Legs whitish. Forewings elongate-triangular, costa gently arched, apex round-pointed, termen nearly straight, oblique; 10 separate; pale-

rosy; lines fuscous; an outwardly-curved transverse line at $\frac{2}{5}$; a finely dentate sinuate line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum; cilia whitish, bases pale-rosy. Hindwings with termen rounded; ochreous-whitish, thinly scaled, translucent; cilia whitish.

This species must not be confused with *Noorda rhodea*, Low., which I have from Townsville.

Type in Coll. Turner.

N.Q., Thursday Island; one specimen.

NOORDA PSAROCHROA, n. sp.

(*Psarochroos*, ashen-grey.)

♀, 27 mm. Head, antennæ, and thorax grey. Palpi 4; grey, shortly white at base. Abdomen grey. Legs grey-whitish; anterior pair grey. Forewings elongate-triangular, costa gently arched, apex rounded, termen bowed, oblique; whitish densely irrorated with grey; markings fuscous; a fine transverse line at $\frac{1}{4}$, produced outwards in centre; a median discal dot; a line from $\frac{3}{4}$ costa to tornus, indented inwards above middle; an interrupted terminal line; cilia grey-whitish with a grey line near base. Hindwings with termen rounded; whitish; some grey suffusion towards termen; cilia whitish with a grey line near base.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

NOORDA EUTACTA, n. sp.

♂, 13 mm. Head and thorax whitish-ochreous. Palpi 3; whitish-ochreous with a few darker scales. Antennæ whitish-ochreous; in ♂ thickened and minutely ciliated. Abdomen whitish-ochreous, towards base and apex whitish. Legs whitish; apex of posterior tibiæ fuscous. Forewings triangular, costa straight for $\frac{3}{4}$, arched towards apex, apex acute, slightly produced, termen sinuate, oblique; whitish-ochreous with some brownish-ochreous suffusion, median area paler; some dark-fuscous scales on costal edge; a broad dark-fuscous transverse line containing some whitish scales at $\frac{2}{5}$; a crescentic median brownish-ochreous discal mark; a dark-fuscous line from $\frac{3}{4}$ costa, at first outwardly oblique, then curved parallel to termen, ending on $\frac{3}{4}$ dorsum; a fine dark-fuscous terminal line; cilia brownish-ochreous. Hindwings with termen rounded, slightly indented above middle, whitish; a faint fuscous subterminal line; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in January; one specimen received from Mr. F. P. Dodd.

MYRIOSTEPHES CITROCHROA, n. sp.

♀, 13 mm. Head, palpi, antennæ, and thorax yellow. Abdomen whitish. Legs pale-yellow. Forewings elongate-triangular, costa straight to near apex, then slightly arched, apex rounded, termen straight, oblique; yellow; markings and some scattered irroration brownish; an oblique ill-defined line from $\frac{1}{6}$ costa to $\frac{1}{3}$ dorsum; a suffused squarish spot on costa before middle; a suffused spot on costa at $\frac{3}{4}$, reaching mid-disc and enclosing two small yellow spots, in this are two darker parallel inwardly oblique lines connected by a cross bar between the two spots, like the letter H; a broad suffused subterminal line, and a few dark scales on termen; cilia pale yellow. Hindwings with termen strongly sinuate; whitish; on termen grey-whitish; cilia whitish.

Type in Coll. Turner.

Q., Brisbane; one specimen.

MYRIOSTEPHES CROCOBAPTA, n. sp.

♀, 14 mm. Head, thorax, and abdomen orange-reddish. Palpi $2\frac{1}{4}$; brown, beneath white. Antennæ brownish-fuscous. Legs brown-whitish. Forewings triangular, costa straight to near apex, apex round-pointed, termen straight, oblique; orange-reddish; markings fuscous; a streak along costa to $\frac{3}{4}$; a fine dentate transverse line at $\frac{1}{4}$; an oval median discal spot; a fine slightly dentate line at $\frac{4}{5}$ parallel to termen; disc between this and termen suffused with fuscous; cilia fuscous. Hindwings with termen slightly sinuate; colour lines and cilia as forewings; terminal fuscous band not extending to postmedian line and narrowing to mid-termen.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

ECLIPSIODES HOMORA, n. sp.

(*Homoros*, similar.)

♂, 16 mm. Head, palpi, antennæ, and thorax fuscous. Abdomen ochreous. Legs grey with whitish-ochreous irroration; posterior pair except tarsi whitish-ochreous. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; fuscous, with dark-fuscous lines; first line indistinct, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, obsolete on margins; a subcostal dot at $\frac{1}{3}$; posterior line from beneath $\frac{2}{3}$ costa bent inwards rectangularly and again downwards to $\frac{2}{3}$ dorsum; discal dot linear, joining posterior line at second angle; a suffused whitish spot on dorsum before posterior line; cilia fuscous. Hindwings with termen rounded, sinuate beneath

apex; ochreous-yellow; a broad fuscous terminal band; cilia fuscous.

Closely allied to *E. crypsixantha*, Meyr.

Type in Coll. Lyell.

N.W.A., Roebourne; one specimen.

ECLIPSIODES DAPSILIS, n. sp.

(*Dapsiles*, abundant, plentiful.)

♂ ♀, 18-20 mm. Head fuscous. Palpi 5; fuscous irrorated with whitish. Antennæ fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax fuscous irrorated with white. Abdomen grey-whitish irrorated with dark-grey. Legs fuscous, irrorated with white; posterior pair mostly white. Forewings triangular, costa straight except at extremities, apex rounded, termen bowed, oblique; white irrorated with fuscous; an incomplete double dark-fuscous line at $\frac{1}{4}$: a reniform postmedian fuscous discal spot, outlined with dark-fuscous; a small fuscous spot on costa at $\frac{4}{5}$, giving rise to a fine dentate line to $\frac{3}{5}$ dorsum; shortly beyond this a broad oblique fuscous streak from apex to dorsum, near but not touching termen; edged anteriorly with dark-fuscous; an interrupted dark-fuscous terminal line; cilia fuscous with a white median line. Hindwings with termen rounded; grey, towards base paler; cilia grey.

Type in Coll. Turner.

Q., Toowoomba and Warwick, a series in March.

ECLIPSIODES ICELOMORPHA, n. sp.

(*Eikelomorphos*, of similar form.)

♂, 22 mm. Head, palpi, and thorax grey, mixed with dark-fuscous. Antennæ dark-fuscous; in ♂ shortly pectinate (1). Legs dark-fuscous irrorated, and tarsi annulated with grey-whitish; posterior pair grey-whitish. Forewings triangular, costa nearly straight, apex rounded, termen slightly bowed, slightly oblique; grey irrorated with whitish-grey, and with dark-fuscous; a slightly wavy dark-fuscous transverse line at $\frac{1}{4}$; an annular dark-fuscous, pale-centred, posteriorly indented discal spot beneath mid-costa; a very fine dentate dark-fuscous line from $\frac{3}{4}$ costa to before tornus; a dark-fuscous apical suffusion continued along termen; cilia dark-grey, apices partly whitish. Hindwings with termen rounded; fuscous with suffused darker median and subterminal lines; cilia dark-grey.

Very similar to *Eclipsiodes drosera*, but immediately distinguished by the pectinated antennæ.

Type in Coll. Turner.

W.A., Albany, in January; one specimen.

ECLIPSIODES PAMMICTA, n. sp.

(*Pammiktos*, mixed.)

♂, 18-19 mm. Head pale-ochreous. Palpi 3; dark-fuscous; base white. Antennæ dark-fuscous, ciliations in ♂ extremely short. Thorax dark-fuscous; apex of patagia and a few scattered scales whitish-ochreous. Abdomen fuscous, apices of segments and tuft whitish-ochreous. Legs dark-fuscous irrorated and annulated with whitish-ochreous; posterior pair mostly whitish-ochreous. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; ochreous-whitish, markings dark-fuscous; a basal patch; a broad transverse fascia before $\frac{1}{4}$; a broad fascia from mid-costa to tornus; a fine dentate line from $\frac{3}{4}$ costa bent inwards into fascia in disc, and continued beyond fascia to mid-dorsum; a broad streak from apex parallel to termen as far as mid-disc; a terminal series of dots; cilia whitish-ochreous barred with fuscous. Hindwings with termen rounded; dark-grey; cilia whitish-ochreous with a broad grey line near base.

Type in Coll. Turner.

N.Q., Kuranda, in October and May; three specimens received from Mr. F. P. Dodd.

ECLIPSIODES MELIPHYRTA, n. sp.

(*Meliphurtos*, mixed with honey.)

♂, 18-20 mm. Head white, a central spot on crown and whole of face dark-fuscous. Palpi 2; dark-fuscous, base white. Antennæ ochreous-whitish with incomplete dark-fuscous annulations; ciliations in ♂ $\frac{1}{4}$. Forewings triangular, costa scarcely arched, apex rounded, termen bowed, oblique; white irrorated and suffused with dark-fuscous; a basal suffusion, succeeded by an interrupted dark-fuscous transverse line at $\frac{1}{4}$; a suffused squarish spot on mid-costa; a sinuate line of dots from $\frac{3}{4}$ costa to $\frac{2}{5}$ dorsum; a large apical and a smaller tornal suffusion connected anteriorly leaving an irregularly-outlined white spot near termen above tornus; cilia pale-ochreous with a dark-fuscous line near base. Hindwings with termen rounded; pale-ochreous; some fuscous suffusion towards termen; cilia pale-ochreous with a fine fuscous line at $\frac{1}{3}$.

Type in Coll. Turner.

Q., Toowoomba, in September; two specimens.

SCOPARIA CHAROPŒA, n. sp.

♂, 16 mm. Head fuscous with a few white scales on crown. Palpi, $2\frac{1}{4}$; fuscous, at base white. Antennæ fus-

cous; ciliations in ♂ ¼. Thorax white, anterior margin and extreme apex fuscous. Abdomen whitish. Legs fuscous, annulated with white; posterior pair white. Forewings elongate, costa slightly arched, apex rounded, termen straight, oblique; white; a dark-fuscous spot on base of costa including a white costal dot; disc before median band irregularly suffused with pale-fuscous tinged with yellowish; a dark-fuscous median band, its anterior edge sharply defined, concave, from ⅓ costa to ⅓ dorsum, its posterior edge very ill-defined, and encroached on by white above middle, containing two dark dots representing orbicular and claviform; a median dark-fuscous discal dot; a dark-fuscous line, somewhat bent outwards, from ¾ costa to ¾ dorsum, giving off anteriorly a short broad line (representing the reniform) about middle, which bifurcates, the branches being very short, one directed towards base, the other towards costa; a pale-fuscous band succeeds this line, separated from it by white dots on costa and dorsum; an irregular dark-fuscous subterminal line, thickened in middle, obsolete towards costa; a fine fuscous terminal line, connected with preceding on veins, not reaching tornus; cilia white, with a median series of fuscous dots. Hindwings 1½; termen slightly sinuate; white, tinged with grey towards termen; cilia white.

Nearest *S. epicryma* and *S. exhibitalis*. This genus is poorly represented in Queensland.

Type in Coll. Turner.

Q., Killarney, in October; two specimens, of which one is in Coll. Meyrick.

Subfamily TINEODINÆ.

A small group characterized by vein 5 of the hindwings arising from the middle of the cell, not approximated to 4 at origin. It consists probably of the scattered remnants of a group which may once have been much more largely developed. To it I refer the genera *Oxychirota*, Meyr.; *Cœnoloba*, Wlsm.; *Tineodes*, Gn.; and *Simæthistis*, Hmps., of which the first three are Australian, the last Indian. The first two are so peculiar that they might be treated as two separate subfamilies, if that were worth while.

Tineodes phœnicea, n. sp.

(*Phoinikeos*, purple.)

♀, 17 mm. Head whitish-ochreous. Palpi 4; whitish-ochreous. Antennæ whitish. Thorax and abdomen whitish-ochreous; the latter with a broad pale-fuscous dorsal band near base. Legs brownish-fuscous; posterior pair whitish above. Forewings elongate-triangular, costa straight to near

apex, then arched, apex acute, slightly produced, termen sinuate, oblique; whitish-ochreous, markings brown-purple; a dark dot at $\frac{1}{4}$, longitudinally elongate; another at middle, narrow and transversely elongate; some scattered irroration in dorsal part of disc; a broad suffused discal blotch beyond middle, triangular with apex towards dorsum; a broad terminal band interrupted by some white scales beneath apex, separated from preceding suffusion by a whitish line, and containing two subterminal whitish spots near tornus; cilia brown-purple several times interrupted by whitish, apices whitish on upper half of termen and at tornus. Hindwings elongate, apex rounded, termen gently rounded; brown-purple; a patch of darker scales at base of dorsum; dorsal edge dark, but interrupted by a whitish spot above tornus; cilia brown-purple several times interrupted by whitish.

Type in Coll. Turner.

Q., Brisbane; one specimen received from Mr. R. Illidge.

TINEODES OXYPRORA, n. sp.

(*Oxuproros*, sharp-prowed.)

♂, 17-18 mm. Head fuscous. Palpi 4; fuscous, Antennæ $1\frac{1}{4}$; fuscous; in ♂ with long ciliations (4). Thorax pale-fuscous. Abdomen fuscous-whitish; tuft ochreous-whitish preceded by a dark-fuscous dorsal bar. Legs fuscous; posterior pair whitish. Forewings elongate-triangular, costa sinuate, slightly excavated in middle, strongly arched in posterior $\frac{1}{4}$, apex acute, slightly produced, termen nearly straight, oblique; ochreous-whitish, with fuscous suffusion and irroration; whole of costa suffused with fuscous; a transverse fuscous mark near base; an inwardly oblique straight fuscous line from mid-costa to $\frac{1}{3}$ dorsum, between which and base the disc is suffused with pale-fuscous; a median transverse fuscous discal mark; an incomplete fuscous line from $\frac{3}{4}$ costa towards tornus; a terminal series of dark-fuscous dots on veins; cilia ochreous-whitish, at apex and tornus fuscous, and interruptedly fuscous on costa. Hindwings with rounded apex, termen slightly excavated; whitish; a transverse fuscous fascia before middle; a broad fuscous terminal band; an interrupted dark-fuscous terminal line; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in August; one specimen (Dodd). Q, Brisbane; one specimen (Illidge).

TINEODES HOLOPHÆA, n. sp.

(*Holophaios*, wholly dusky.)

♂, 19 mm. Head and palpi fuscous. Antennæ fuscous; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen fuscous with

dull purple reflections; apices of abdominal segments more or less whitish; tuft ochreous-whitish. Legs pale fuscous; tarsi annulated with whitish; posterior pair except tarsi whitish. Forewings elongate-triangular, costa straight to $\frac{3}{4}$, then strongly bowed, apex acute, termen doubly sinuate, strongly oblique; fuscous with dull purple reflections; markings obscure, ochreous-brown; a line from $\frac{1}{4}$ costa to $\frac{2}{5}$ termen; a linear median discal mark preceded by a whitish area; a posterior line from beneath $\frac{3}{4}$ costa, sinuate, to $\frac{3}{4}$ dorsum; a fine terminal line; cilia fuscous barred with ochreous-whitish. Hindwings with apex rather pointed, termen slightly excavated; colour as forewings; cilia fuscous.

Type in Coll. Lyell.

N.Q., Kuranda, in November; one specimen received from Mr. F. P. Dodd.

New Australian Lepidoptera.—No. XXV.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read August 4, 1908.]

NOCTUIDÆ.

AGROTINÆ.

*Meliceptria flavitincta, n. sp.

♀, 34 mm. Head, palpi, thorax, and abdomen pale yellow. Legs pale yellow tinged with fuscous. Forewings elongate, moderate, costa gently arched, termen rounded oblique; pale yellow, with dark fuscous, moderately thick, markings: a short basal fascia; a strongly waved fascia from costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$, with an elongate projection outwards below middle; a moderately large round discal spot; a transverse fascia, somewhat waved, from costa just beyond middle, reaching only half across wing; a waved fascia from just beyond last fascia, from beneath costa to dorsum at $\frac{3}{4}$ strongly bowed on upper half; a transverse fascia beyond this and parallel, more or less broken into spots and becoming obsolete in middle; a row of spots along termen; cilia pale yellow with fuscous spots at extremities of veins. Hindwings with termen rounded; pale yellow; a broad fuscous band along termen; cilia pale yellow.

Derby, Western Australia. One specimen (without date).

Proteuxoa euglypta, n. sp.

♀, 34 mm. Head, palpi, antennæ, and thorax brownish-fuscous, mixed with whitish, thorax with a narrow transverse anterior whitish band, anteriorly edged with a fine line of black; a short transverse blackish bar above middle of thorax, and two more or less quadrate spots on posterior half, upper largest, patagia broadly white, with a fine fuscous anterior line. Legs fuscous, sprinkled with white, tibiæ and tarsi banded with white. Forewings elongate-moderate, costa straight, termen rounded, faintly waved; ochreous-fuscous, with whitish markings, finely edged with black; a spot at base; a strongly waved moderately thick transverse fascia, from costa near base, reaching more than half across wing; a tridentate oblique fascia from costa at $\frac{1}{5}$ to $\frac{1}{3}$ dorsum, connected with previous fascia in middle by a short

* The names preceded by an asterisk were kindly suggested by Sir G. Hampson, to whom I am indebted for considerable help in determining many species.

bar; orbicular, ovoid, large, with a black central spot; reniform large, both portions black centred, a round spot between dorsum and orbicular; a short oblique mark just above reniform; a row of lunate marks forming a moderate fascia, from costa at $\frac{3}{5}$ to dorsum at $\frac{2}{3}$, curved outwards in middle; a somewhat suffused subterminal line, from costa at apex, where it is broadest to anal angle, slightly indented in middle; a row of small posteriorly black-edged lunate marks along termen; cilia fuscous, mixed with white. Hindwings with termen unevenly waved; pale whitish-ochreous; a moderately broad dull fuscous transverse fascia, from $\frac{4}{5}$ to dorsum at $\frac{3}{4}$, broader on lower half and suffusedly continued narrowly along dorsum to base; a parallel fascia just beyond, from costa at $\frac{5}{6}$ to anal angle; a fine fuscous line along termen; cilia grey-whitish.

Bolivar, South Australia. One specimen; in April.

PROTEUXOA DELOPTIS, n. sp.

♀, 36 mm. Head, palpi (antennæ broken), legs, and thorax dark ochreous-fuscous, minutely mixed with black and whitish scales; markings white, obscurely indicated; a short fascia at base; a waved fascia from $\frac{1}{4}$ of costa to $\frac{1}{4}$ dorsum, very obscure on lower half; orbicular and reniform well developed, edged with blackish, and with a black central spot in each; a spot on costa above reniform; four other small spots on costa between this and apex; a waved line from beneath costa at $\frac{3}{4}$ to dorsum at $\frac{4}{5}$, anteriorly edged with blackish; a suffused whitish subterminal line; a row of black spots along termen, anteriorly edged with whitish; cilia dark fuscous, mixed with whitish. Hindwings with termen unevenly waved; whitish; a fuscous suffusion at apex; a fine line along termen; cilia grey-whitish.

Dundas, Western Australia. One specimen, in November.

ACRONYCTINÆ.

PROMETOPUS METANEURA, n. sp.

♂ ♀, 25-28 mm. Head reddish fuscous, palpi and antennæ fuscous. Legs, thorax, and abdomen grey-whitish, thorax with anterior narrow ferruginous band. Forewings elongate, moderate, costa nearly straight, termen rounded oblique; dull grey-whitish irregularly mixed with darker fuscous and sparsely and suffusedly mixed with orange reddish scales; a short red streak along fold, from base to $\frac{1}{4}$; orbicular and reniform red, both more or less centred with whitish, posterior half of reniform sometimes wholly whitish; 3 fuscous equidistant costal spots near base, at $\frac{1}{5}$ and $\frac{1}{2}$ respectively; a curved series of fuscous dots from costa at $\frac{3}{4}$

to dorsum at $\frac{3}{4}$; a dull reddish fuscous shade beyond throughout, limited by a waved tridentate line; space between this and termen pale ochreous-reddish; a black line along termen, interrupted and forming spots; cilia dull fuscous reddish. Hindwings fuscous, basal area whitish; an obscure fuscous discal spot, line along termen as in forewings; cilia silvery-white, fuscous around apex.

Broken Hill, New South Wales; Adelaide, South Australia. Several specimens; in March, April, and November.

LYMANTRIADÆ.

Colussa psammochroa, n. sp.

♂, 54 mm. Head, palpi, thorax, and abdomen ochreous-grey, strongly mixed with ferruginous-fuscous, last three abdominal segments fuscous. Antennæ whitish, pectinations 10, fuscous. Legs ochreous-grey. Forewings elongate, triangular, costa nearly straight, termen gently bowed, very faintly waved; pale ochreous-whitish, with fuscous markings; a rather broad, curved fascia from costa at $\frac{1}{3}$ to $\frac{1}{3}$ of dorsum, edged anteriorly by a line of blackish and having on its posterior edge a black-edged spot in cell; a moderate black elliptic ring in end of cell, centred with ground colour; a second fascia, slightly broader than first, from costa at $\frac{4}{5}$ to dorsum at $\frac{4}{5}$, anteriorly edged by a waved line, which is separated from fascia by a narrow line of ground colour; posterior edge of fascia waved, and limited by a waved black line throughout; cilia greyish-ochreous. Hindwings pale greyish-ochreous, basal hairs dense, ochreous; a suffused fuscous discal spot; second fascia as in forewings, but much paler, becoming distinct on posterior edge only, underside of wings as above, markings of upper side reproduced; discal spots strongly reproduced; hindwings with two black, white centred discal spots at $\frac{1}{3}$ and before middle, first smaller. In the neighbourhood of *ocellata*, Walk.

Cockburn, South Australia. One specimen; at light.

PSYCHIDÆ.

Oiketicus aristocosma, n. sp.

♂, 60 mm. Head and face bright orange. Thorax and abdomen black, patagia orange, thorax beneath orange, abdominal segments broadly orange, excepting first segment which is black. Antennæ black, pectinations at greatest length 10, on apical half 1. Legs black. Forewings very elongate, costa nearly straight, termen very oblique, continuous with dorsum; velvety black, all veins outlined in whitish; cilia dark-fuscous. Hindwings very small, somewhat isosceliform; apex bluntly prominent, termen rather

strongly sinuate; anal angle produced; colour, markings, and cilia as in forewings. Case:—Fusiform. Yellowish-ochreous internally, externally thickly covered with very fine needle-like pieces of grass, and ornamented with the portions of (*? Juncus*) stems, placed indiscriminately throughout, but always with sharp point directed forward, generally about 25 mm. long and fairly conspicuous. These being shorter towards the terminal portion of case. Length of entire cocoon, $8\frac{1}{2}$ inches; breadth, at greatest, $1\frac{3}{4}$ inches. This magnificent creature is probably the largest *Psychid* yet discovered. The nearest approach to it for size is *Eumeta maxima*, Butl. (53 mm.), from the Duke of York Island. The present species is closely allied to *O. elongatus*, but is very different in the imago and formation of cocoon. If any intermediate forms are discovered it may possibly prove to be a geographical form of that species, yet I scarcely think so. Larva unknown.

Kuranda, Queensland. One specimen, from Mr. F. P Dodd; bred in January.

PLUTORECTIS THERMACULA, n. sp.

♂, 22 mm. Head, thorax, and abdomen black. Antennæ and legs fuscous, antennal pectinations at greatest length 8. Forewings elongate, moderate, costa gently arched, termen hardly rounded oblique; 4 and 5 stalked; 8 and 9 stalked; 7 separate from 8; dark fuscous; a dull ochreous spot, resting on vein 1 in middle; cilia black. Hindwings with termen rounded; 4 and 5 long stalked; 6 and 7 remote; dark fuscous, lighter than forewings and somewhat bronzy-tinged; cilia dark fuscous. Distinct by its black colouring and ochreous spot on forewings.

Kuranda, Queensland. One specimen; bred by Mr. F. P. Dodd in January. A second specimen from Cooktown (E. A. Olive) is apparently the same, but being abraded admits of some doubt.

Case:—Cylindrical, tapering, thickly ornamented with short thick pieces of stems of *Eucalyptus sp.*, ranging in length from 5 to 15 mm., those at the lower portion being much shorter and the other gradually increasing in size until the maximum is reached at the anterior portion, which is generally attached to the food plant. The ornamentations are placed indiscriminately, but when viewed vertically the case has a triangular appearance, with the pieces of stem protruding at intervals. The extreme height of case is 17 mm.: the apex, which is ornamented with small pieces of *Phyllodia*, is about 5 mm. and the base about 15 mm. in diameter. Larva unknown.

GEOMETRINA.

MONOCTENIADÆ.

Monoctenia niphosema, n. sp.

♀, 50 mm. Head and palpi dull reddish-carmine, palpi beneath fuscous tinged, antennæ ochreous, pectinations 1. Thorax dull ochreous-carmine, becoming strongly suffused with carmine on anterior half. Abdomen grey, mixed with dull purple laterally and beneath. Legs ochreous, anterior coxæ dull carmine. Forewings elongate moderate, costa slightly arched on basal third, slightly sinuate beyond middle, termen rather strongly bowed, oblique, slightly sinuate beneath apex, apex somewhat produced; dull ochreous-carmine, median third strongly suffused with carmine; costal edge narrowly carmine throughout; a well-defined snow-white spot in cell at $\frac{1}{4}$ from base, faintly edged with fuscous; a large dull fuscous spot in posterior extremity of cell; dusted with whitish ochreous scales; a transverse fuscous line, slightly curved outwards, from about $\frac{3}{4}$ of costa to $\frac{3}{4}$ of dorsum; a row of fuscous dots, considerably beyond but parallel to line; cilia carmine tinged with fuscous. Hindwings with termen moderately rounded; greyish-ochreous, broadly tinged with fuscous-purple along termen; cilia dull purplish.

Perth, Western Australia. One specimen; in November.

Dichromodes (?) triglypta, n. sp.

(?♀) 28 mm. Head, palpi, and thorax fuscous. (Antennæ broken.) Abdomen ochreous. Legs fuscous. Forewings elongate, triangular, costa nearly straight, termen oblique; brownish-ochreous; a thick erect black line from dorsum at $\frac{1}{3}$ towards costa but hardly reaching it; an irregularly waved moderately thick black line from costa at about $\frac{2}{3}$ to dorsum at about $\frac{2}{3}$, with a sinuation outwards in middle, edged posteriorly by its own width of clear white and anteriorly by its own width of light ferruginous; space between this and erect line suffused with dull ferruginous; a well-defined clear white line from costa at $\frac{5}{6}$ to anal angle, with a strong sinuation inwards just above middle, where it becomes thicker, strongly sinuate above and below this, edged anteriorly by a thick dark fuscous shade throughout; a row of fine white dots along termen; cilia ochreous-fuscous. Hindwings with termen rounded; pale ochreous-whitish; faint fuscous discal dot; two parallel pale fuscous waved lines, from costa at $\frac{2}{3}$ and $\frac{3}{4}$ respectively, reaching dorsum at $\frac{2}{3}$ and $\frac{3}{4}$ respectively; cilia pale ochreous.

Doubtfully referable to *Dichromodes*, the head being in bad condition; it is a pretty and distinct insect.

Dundas, Western Australia. One specimen; in November.

TORTRICINA.

TORTRICIDÆ.

Capua petrochroa, n. sp.

♂, 18 mm. Head, palpi, antennæ, and thorax pale ochreous-yellow, thorax anteriorly fuscous tinged. Legs pale ochreous-whitish. Forewings moderate, costa gently arched, termen rather oblique; pale ochreous-yellow; costal edge shortly strigulated with fuscous; outer edge of basal patch fuscous, with a paler projection in middle; groundcolour between this and base deeper ochreous-yellow; median patch yellowish fuscous, moderately distinct, very oblique, anterior edge well defined, posterior edge suffused into general groundcolour, from middle of costa nearly to dorsum at anal angle; a moderate fuscous triangular costal patch at $\frac{3}{4}$; 3 transverse series of pale yellowish-fuscous spots from costa between triangular patch and apex, reaching more or less across wing, first one becoming very clear on median portion; cilia pale ochreous-yellow, mixed with darker. Hindwings and cilia pale whitish-ochreous.

Birchip, Victoria. One specimen; in November.

Capua ceramica, n. sp.

♂, 20 mm. Head, palpi, antennæ, and thorax reddish-fuscous, palpi internally whitish. Abdomen grey. Legs greyish mixed with fuscous. Forewings moderate, costa gently arched, termen oblique, hardly bowed; reddish fuscous, irrorated with rows of transverse fuscous dots; basal and median patches not indicated; a dull fuscous suffused spot on upper edge of cell, at about middle; a similar but larger spot at posterior end of cell, the transverse rows of dots towards termen become more or less confluent, and appear as suffused streaks; cilia greyish, with fuscous and ferruginous spots. Hindwings grey, strigulated throughout with transverse rows of fuscous dots; cilia grey.

Monbulk, Victoria. One specimen; taken in September.

Capua oxygona, n. sp.

♀, 16 mm. Head, thorax, antennæ, and abdomen fuscous. Palpi and legs ochreous-white, legs fuscous tinged. Forewings elongate, moderate, costa rather strongly arched, termen oblique; light ochreous-fuscous; costa shortly strigulated with fuscous; basal patch obsolete; anterior edge of median patch moderately defined, very oblique, from costa before middle to dorsum above anal angle; slightly sinuate on upper half, curved on lower half; whole of wing beyond this fuscous; posterior edge of median band very irregular

and gradually merged into groundcolour; a moderate reddish fuscous patch on middle of termen; cilia ochreous, with a reddish fuscous spot opposite spot on termen. Hindwings fuscous; cilia grey, with a fuscous basal line.

Cooktown, Queensland. One specimen; taken in November.

CONCHYLIDÆ.

Paramorpha perileuca, n. sp.

♂, 14 mm. Head and thorax white. Palpi very long, white, sharply dark fuscous beneath. Antennæ and legs grey-whitish. Abdomen silvery grey, darker beneath. Forewings elongate, moderate, costa hardly arched, termen obliquely rounded; cinereous-grey-whitish, with numerous blackish scales throughout forming a fine irroration; markings blackish, costal edge nearly blackish from base to middle, beneath which is an elongate streak of clear whitish; two spots, obliquely placed near base; a spot below fold at $\frac{1}{4}$, another on fold at $\frac{1}{3}$, and a third midway above and between; two others larger and more distinct, transversely placed, at end of cell; two or three obscure spots along lower edge of whitish streak, sometimes absent; an ochreous fuscous suffusion in cell; four equidistant, short, oblique costal streaks, between $\frac{2}{3}$ and apex; a more or less interrupted line along termen; cilia whitish with fuscous median and subterminal lines. Hindwings thinly scaled; grey-whitish; cilia as in forewings. The smallest species of the genus.

Melbourne, Victoria. One specimen; in March. I have seen two others from Castlemaine, Victoria.

TINEINA.

XYLORYCTIDÆ.

Xylorycta argyrota, n. sp.

♂, 16 mm.; ♀, 20 mm. Head, palpi, antennæ, and thorax silvery-whitish, palpi internally whitish. Abdomen greyish ochreous, beneath broadly banded with fuscous. Legs silvery-whitish, posterior pair ochreous. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; silvery-whitish, almost white in some specimens; a moderately clear white costal streak, from base to $\frac{3}{4}$, posteriorly attenuated; veins towards termen obscurely outlined with pale fuscous; cilia whitish, faintly ochreous tinged. Hindwings grey; cilia pale greyish-ochreous.

Henley Beach, South Australia. Fifteen specimens; in March and November. Bred from stems of *Juncus sp.* The larva form ball-shaped masses of grey flocculent down on the

seed heads; sometimes there are three of these masses on one stem, in others they are formed at the base of the stem, and there become much larger.

Cryptophaga lasiocosma, n. sp.

♀, 54 mm. Head, palpi, antennæ, thorax, legs, and abdomen snow-white, antennæ fuscous on terminal $\frac{2}{3}$, thorax ochreous anteriorly, abdomen with reddish segmental margins, first segment broadly banded with orange ochreous. Tarsi banded with black. Forewings elongate, moderate, costa gently arched, termen rounded, oblique, 2 from $\frac{2}{3}$; shining snow white; markings black, a spot near base; a larger one in cell at $\frac{2}{3}$, and another on fold in middle; one or two black scales near tornus; cilia shining snow white. Hindwings and cilia shining snow white.

Kuranda, Queensland. One specimen, from Mr. F. P. Dodd; bred in December.

Nearest *Argyrias*, Turn., but differs in the discal dots, *clear* white hindwings, etc.

Agriophara platyscia, n. sp.

♀, 36 mm. Head, palpi, antennæ, and thorax, ashy-grey-whitish, palpi beneath white. Abdomen grey. Legs grey. Forewings elongate, moderate, costa arched rather strongly, termen obliquely rounded; ashy-grey-whitish; a broad, more or less interrupted longitudinal shade, from base to apex, containing several short narrow blackish elongate streaks, those towards termen (where shade is darker) being especially prominent; extreme costal edge whitish, from before middle to apex; cilia ashy-grey-whitish. Hindwings and cilia light greyish-fuscous. Easily known by the thick longitudinal streak.

Tasmania. One specimen; probably in November.

ŒCOPHORIDÆ.

Guestia eurybapta, n. sp.

♂, 26 mm. Head, palpi, and thorax reddish-ochreous. Antennæ fuscous. Abdomen ochreous, segmental margins silvery-grey. Legs fuscous, middle and posterior tibiæ and tarsi banded with reddish-ochreous, posterior pair ochreous. Forewings elongate moderate, costa gently arched, termen rounded, apex rounded; reddish-ochreous, irrorated with darker; a short dark fuscous streak along fold, from near base to $\frac{1}{5}$, slightly curved upwards at posterior extremity; a suffused fuscous elongate streak at $\frac{1}{3}$ above middle; indications of a similar streak on fold slightly before; an obscure

leaden-fuscous suffused spot above anal angle, with a small fuscous mark above on upper edge, groundcolour between paler ochreous and spot-like; a curved series of semi-confluent fuscous dots, from costa at $\frac{5}{6}$ to dorsum above anal angle, not indented; a row of reddish elongate spots along termen; cilia reddish-ochreous, darker at base, becoming greyish-ochreous on terminal third. Hindwings pale ochreous-grey; cilia pale greyish-ochreous, becoming ochreous at base.

Closely allied to *Paradelpha*, Low., but immediately separated by the ochreous-grey hindwings.

Broken Hill, New South Wales. Four specimens (all ♂); taken in April.

TINEIDÆ.

Eudrymopa cyanoleuca, n. sp.

♂, 20 mm. Head, palpi, and thorax dull bluish-white. Antennæ fuscous, serrated. Abdomen greyish. Legs grey, more or less infuscated. Forewings elongate, moderate; costa gently arched in middle; termen obliquely rounded; dull bluish-white, with some scattered fuscous and chocolate dots; costal area slightly tinged with fuscous; a narrow chocolate fascia, slightly curved outwards from costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$; a chocolate apical patch; cilia bluish-white, mixed with fuscous, and with a chocolate spot at apex. Hindwings with termen somewhat pointed; pale fuscous; cilia fuscous grey.

Gisborne, Victoria. One specimen (*Lyell*). Mr. Lyell bred this species; larva green, forming a slight silky cocoon beneath the bark of *Eucalyptus sp.*

Scardia inconcisella, Wlk.

I have recently had occasion to examine the structure of several specimens of this species, and as they present some peculiarities I record them. The *Tineidæ* seldom maintain the true or normal characters throughout. In the forewings of one specimen before me vein 4 is present, 7 and 8 are stalked (portion of 8 absent). In another, 7 and 8 are present, but not stalked, and 4 is absent; and another, 7, 8, and 9 form a point, but not stalked, and 4 is absent.

ELACHISTIDÆ.

Elachista leucophasa, n. sp.

♀, 10 mm. Head, palpi, thorax, antennæ, abdomen, and legs white. Forewings lanceolate; white, strewn with minute fuscous scales throughout, except along costa, which is narrowly white; two rather obscure, pale fuscous streaks, one along fold from base to about middle, the other along

lower edge of cell; cilia white, rather thickly mixed with fuscous. Hindwings narrow-lanceolate; grey; cilia pale ochreous grey.

Semaphore, South Australia. One specimen, in September.

E. (?) METALLIFERA, n. sp.

♂ ♀, 8-10 mm. Head bronzy-ochreous, palpi orange, terminal joint fuscous. Thorax fuscous, beneath metallic-orange. Antennæ fuscous, basal joint dull yellow. Abdomen coppery-fuscous. Legs orange, banded with fuscous. Forewings ovate-lanceolate, slightly dilated posteriorly; orange; a very broad shining metallic purplish patch, occupying median $\frac{2}{3}$ of wing; mixed with fuscous and containing on its costal edge two somewhat triangular black spots; its anterior edge with a few greenish metallic scales, posterior edge fiery metallic-coppery; some greenish metallic scales at base of wing; two narrow curved lines of groundcolour near apex, separated by narrow streak of dull metallic-coppery, which appears raised; a smaller mark, but more obscure on lower edge of streak of groundcolour; cilia dark fuscous. Hindwings and cilia bronzy-fuscous.

Townsville and Cairns (*Dodd*) and Duaringa, Queensland. Several specimens; in December.

LIMNŒCIA IDA, n. sp.

♂ ♀, 8-10 mm. Head, palpi, thorax, and antennæ ochreous-white, second joint of palpi with a fuscous terminal ring, becoming fuscous beneath towards base. Antennæ more or less annulated with fuscous, especially posterior half. Abdomen dull ochreous, becoming broadly fuscous on last three segments. Legs ochreous fuscous, tibiæ and tarsi sharply banded with black. Forewings elongate, rather narrow; dark purplish-fuscous, with ochreous-white markings; a narrow oblique irregular band from $\frac{1}{4}$ of costa to dorsal streak at $\frac{1}{4}$, edges waved; a similar streak from middle of costa to very near extremity of dorsal streak, much narrower on lower half; a third band formed into two roundish spots, caused by groundcolour intervening from $\frac{5}{6}$ of cell to dorsum near anal angle; a moderately thick ochreous-orange streak along dorsum, from base to beyond middle; cilia dark fuscous, with a moderately large whitish apical spot. Hindwings lanceolate fuscous; cilia light fuscous.

Henley Beach, South Australia. Several specimens, bred by my sister (to whom I have dedicated it) from larva feeding in seed-heads of *Juncus sp.;* in November.

Limnœcia zonomacula, n. sp.

♀, 20 mm. Head ochreous-white. Palpi ochreous-white, terminal joint and lower $\frac{2}{3}$ of second joint beneath dark fuscous. Thorax dark purplish-fuscous. Antennæ dark purplish in middle, terminal fourth whitish-ochreous. Abdomen ochreous-yellow. Legs dark fuscous, posterior tibiæ banded with ochreous-whitish, all tarsi ringed with ochreous-yellow. Forewings lanceolate-ovate; very dark purplish fuscous, somewhat shining; 3 ochreous-white bands; first broad, from $\frac{1}{3}$ costa to $\frac{2}{3}$ across wing; second from middle of costa to $\frac{5}{6}$ of wing, not quite reaching dorsum, somewhat crescentic; third, rather narrow from $\frac{3}{4}$ costa to anal angle, somewhat curved outwards at lower extremity; cilia dark fuscous, with an ochreous-white apical patch. Hindwings ovate lanceolate; dark fuscous.

Penola, South Australia. Two specimens; in October. Mr. Meyrick has it from Hoyleton, South Australia.

Limnœcia crossomela, n. sp.

♀, 22 mm. Head, palpi, antennæ, and thorax ashy-grey-fuscous. Legs ashy-grey, posterior pair yellow. Forewings elongate, moderate, costa gently arched; ashy-grey-whitish, mixed with fine fuscous scales; markings black; a dot on fold at $\frac{1}{3}$ from base; a second just above and slightly before; a third in middle, lying on upper edge of cell; a curved, somewhat lunate mark at end of cell; a moderately thick line from costa at $\frac{5}{6}$ to dorsum at $\frac{5}{6}$, indented beneath costa, thence curved to termination, where it becomes more distinct; a suffused row of marks along termen; cilia ashy-grey-whitish. Hindwings with apex rather pointed; light fuscous; cilia yellow.

Hoyleton, South Australia. One specimen (taken in September probably); and one at Broken Hill, New South Wales; in November.

NOTES ON THE GEOLOGY OF THE MOUNT LOFTY RANGES CHIEFLY THE PORTION EAST OF THE ONKAPARINGA RIVER.

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PLATES I. AND II.

[Read May 5, 1908.]

The notes presented in this paper form a record of work done during the years 1902 to 1904 inclusive, but principally during the latter half of 1904.

It is not claimed that they give a complete description of the district. The area is so large and its geographical structure so complicated that it will require years of patient, painstaking work before its intricacies can be unravelled. I had hoped to carry out this research, but my removal to Sydney brought my labours to a sudden conclusion. All I can hope to do is to give a general account of my work in its unfinished condition, and to suggest lines of research which may be followed by future observers. My best thanks are due to the officers of the Mines Department of South Australia for obtaining a pass for me on the South Australian railways, which enabled me to take journeys which would otherwise have been beyond my means. Mr. Gill, Under-Treasurer, also interested himself on my behalf, and I would include him in this recognition.

I have also to thank the Rev. J. W. Gower for repeated hospitality and advice as to routes, etc. To Mr. Stirling Smeaton, B.A., I owe a debt of gratitude also. He has interested himself much in my work, and has on many occasions assisted me by obtaining information as to altitudes, etc.

No detailed traverses were made along the strike of the beds, as many of the correlations did not become obvious until the observations were worked up recently. I traversed the whole length of the railway lines of the district on foot, and most of the main roads by bicycle, and made a number of pedestrian excursions across country as well.

Mr. Howchin has given a complete and detailed account of the geology of the western portions of the Mount Lofty area,[1]

[1] Trans. and Proc. Roy. Soc., S.A., vol. xxviii. (1904)., p. 253. *Ibid*, vol. xxx. (1906), p. 227. Aus. Assoc. Ad. Soc., vol. xi., p. 414.

and has summarized the literature, so that there is no necessity for me to cover the ground he has so ably traversed. These papers were not published at the time I was working in South Australia.

The choice of the Onkaparinga as the western limit of the area under discussion is not an arbitrary one. The river follows a distinct axis of earth-structure; it is, in fact, a typical subsequent stream. West of it there is considerable monotony in the rocks. The dominant types are soft quartz schists (of the Mount Lofty series) and hard quartzites. Here and there, as at Carey's Gully, and thence northward to Forest Range, there is a strong belt of conglomerate containing pebbles of titaniferous sandstone. Mr. Howchin has shown this to be the basal bed of the Lower Cambrian, and it will form a most useful datum-horizon for the detailed mapping of the area. On the Norton Summit-Woodside road the conglomerate is interbedded (?) with an extremely tough blue slate, vesicular in places, which is very much like the non-boulder-bearing portions of the Sturt River glacial beds. A little to the south of the Balhannah-Uraidla road the conglomerate is abruptly truncated by an east and west fault, which causes it to abut against the blue slate. It appears probable that this fault may be connected with the ore deposition at the Balhannah Mine.

Neither blue slate nor conglomerate appears in the railway cuttings between Bridgewater and Ambleside. Almost the whole of this stretch of country is occupied by soft friable sandstone, of the Mount Lofty species.

At Grunthal there occurs a well-marked shatter-zone. The crushed rocks are much impregnated with iron, and injected by large quartz veins. No doubt these phenomena are responsible for the ore deposition at this point. A very pretty example of extreme plication is shown by a series of slates in the railway cutting close to the Ambleside down distant signal. About a mile north-east of Ambleside there is another occurrence of cellular blue slate, but it is doubtful whether this is the same rock as that noted above at Forest Range.

Coming now to the area with which I wish more particularly to deal, I shall first describe in some detail the partial sections afforded by several routes.

Owing to the irregular way in which these lines of section cross one another, it is difficult to devise any logical method of presenting the observations. I shall, therefore, give the details in approximately the order in which I observed them. The first section to be described is that between Balhannah and Murray Bridge along the railway line.

Thoroughly crystalline schists are first met with about a mile west of Mount Barker Junction. They have the character of tremolite- and actinolite-schists, passing in places into a perfect tremolite rock. Their strike is north and south and their dip vertical. From Mount Barker Junction for about one and a half miles east we have soft friable white quartz schists, lithologically like those of the Mount Lofty series. Structurally they appear to be members of the schistose series, though it is possible they form an outlier of the Mount Lofty beds infolded into the older rocks.

About one and a half miles east of the Junction these rocks are affected by a marked shatter-zone, and become much veined with quartz. Approaching Nairne we pass again to schists, which become spotted, owing to development of incipient andalusite. This mineral increases in importance until just to the east of Nairne Station the schist shows well-marked knots of it. Rocks of this type are widely developed amongst the schists of South Australia, and as I shall have to refer to them frequently I shall coin the name "Paringite" for them, after Paringa, a group of railway cottages between Nairne and Callington, where they are typically developed.

Paringite is a moderately coarse, friable, silvery, muscovite-biotite-schist, with very wavy lamination, and with very prominent "knots" or "eyes" of impure andalusite, which may be upwards of an inch in diameter.

From the thirty-five and a half mile peg (about half a mile east of Nairne) to the thirty-six and a half mile peg the rocks (schist and quartzite) are much shattered, all the evidence pointing to a zone of intense fracture. For some distance east of the fracture-zone there is a notable discordance between the dip of the beds and the dip of their cleavage planes. This discordance gradually disappears as we pass eastwards, and is additional evidence of powerful earth movement in the neighbourhood.

There is no outcrop of quartzite in the railway section at all comparable with the immense mass of Mount Barker.[2] From the thirty-eight mile peg to about the forty-one mile peg the character of the rocks is pretty uniform. They consist of a thick series of mica schists, with occasional bands of sericite schist. Their dip is very constantly about E. 5 deg. N. at from 30 deg. to 40 deg. Several small faults

[2] Mount Barker and Mount Barker town are nearly three miles apart, so that there is considerable ambiguity in speaking of Mount Barker. When the name is used in this paper it will refer to the mount itself; when the town is intended it will be specified.

leading to the N.N.E. appear about the thirty-nine and a half mile peg. For more than a mile east of the forty-one mile peg the dips again become disturbed, and another fracture-zone is suggested in the neighbourhood of the railway cottages at Paringa. The rocks are thrown into sharp folds.

At about forty-two and three-quarter miles from Adelaide another belt of paringite occurs. It is quite possible that there may be two or more distinct horizons of this rock, but I think it more probable that a single belt of it has suffered repetition through heavy strike faults or by folding. From this point to Callington the rocks are chiefly tough mica- and chlorite-schists. At Callington itself the schists are strongly mineralized, and the Callington Mine was at one time an important ore-producer. There is a wide break in the section here caused by the valley of the Bremer River, which occupies a broad U-shaped valley. On the eastern slope of this valley there is a very considerable area of sand-dunes. These I think represent the advanced guard of the Lake Alexandrina beach sands moving northwards along the Bremer valley. Above the reach of the sand here the rocks exposed consist of dark and very tough biotite schists, with high angles of dip towards the E.S.E. These form a ridge separating the Bremer valley from a much wider one in which Monarto lies. This valley, though possessing a well-defined north and south trend, is not occupied by a stream like the Bremer. The absence of a stream is to be accounted for by repeated captures by small streams running direct to the Murray, as, for instance, the Rocky Gully Creek, through whose gorge the railway line passes.

Like the Bremer Valley, this one is much filled with drift sand, which hides the bed-rock from view. Where the sand-drifts have been stripped there are large areas of solid ringing travertine. This formation, almost ubiquitous in South Australia, is conspicuous by its absence or rarity in the area between Nairne and Callington. In this area it is prevented from forming partly by the comparatively high and well-distributed rainfall, but mainly by the low lime content of the schists. Its conspicuous developments near Monarto, and thence, in patches, east to Murray Bridge, is due to the occurrence of thin patches of tertiary limestone lying on the upturned edges of the schists. The latter outcrop at intervals over the floor of the valley, but do not give rise to conspicuous features there. About two and a half miles east of Monarto Station is the western boundary of a strip of granite intrusive into the schists. Though this granite has a considerable north and south extent, its width from east to west is very little over one mile. While the schists on

both sides are thoroughly metamorphosed and recrystallized the granite, though somewhat foliated, is not very highly altered, showing that, while it has suffered from some of the later earth movements, it is very considerably younger than the schists.

Lying to the east of the granite there is a wonderful variety of rock types, the normal schists having undergone extensive contact metamorphism. The resulting rocks are well exposed in the cuttings through Rocky Gully. Close to the granite contact are highly crystalline quartz schists, with bundles of radiating tremolite needles. These are extremely handsome rocks in hand specimen. They are succeeded by very coarse felspathic biotite schists, through which are numerous veins of pegmatite; in fact, there is a regular *lit par lit* injection in places. Some of the schists in texture and composition approach gneisses. In one of the pegmatite veins two small crystals of beryl were observed: this occurrence is interesting, from the fact that the same mineral occurs in the very coarse pegmatites of Williamstown, thirty-eight miles to the north-west.

Between Rocky Gully and Murray Bridge no outcrops other than eocene limestone are met with. As might be expected, there is a very notable development of travertine.

The road sections approximately parallel with the railway will now be described. Along the road from Oakbank to Woodside there occur schists generally similar to those met with just west of Mount Barker Junction. These bound the Onkaparinga valley on the east; on the west occur less schistose quartzites and slates, the river following the junction between the two series for a considerable distance.

The road section from Nairne to Callington *via* Dawesley and Kanmantoo is also very interesting. For some two and a half miles from the Railway Station at Nairne the rocks are schists and quartzites similar to those encountered along the railway line. Just to the east of the town is an outcrop of quartzite lithologically similar to that forming Mount Barker, but there is no trace of the very strong feature formed by the Mount Barker escarpment. In a quarry one and a half miles east of the town biotite schists are exposed with a dip of W. 10 deg. S. at 85 deg., that is, in a direction opposite to that of the dominant dips of the district. It is probable that this reversal is caused by a very sharp flexure, perhaps combined with faulting. A little farther east the direction of dip is E. 10 deg. S. at varying angles down to as low as 35 deg.

At about two and a half miles from Nairne there occurs a thin band of extremely tough, vesicular, blue slate like

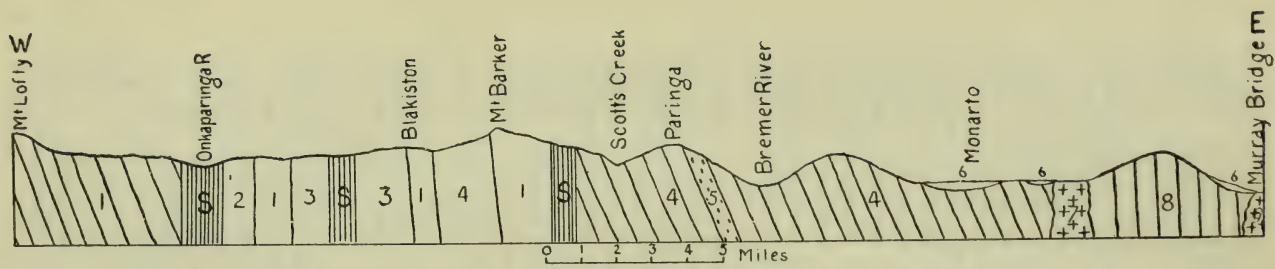

Fig. 1.—Geological Section, considerably generalized, from Mount Lofty to Mount Barker, thence to Murray Bridge. Profile only approximately correct.

Legend.—1, Quartzite and quartz schist; 2, slaty rocks; 3, actinolitic schists; 4, mica schist; 5, paringite; 6, tertiary and recent deposits; 7, Monarto granite; 8, Rocky Gully gneisses and schists; 9, Murray Bridge granite; SS, shatter-zones. N.B.—For details of section between Blakiston and Mount Barker see fig. 2.

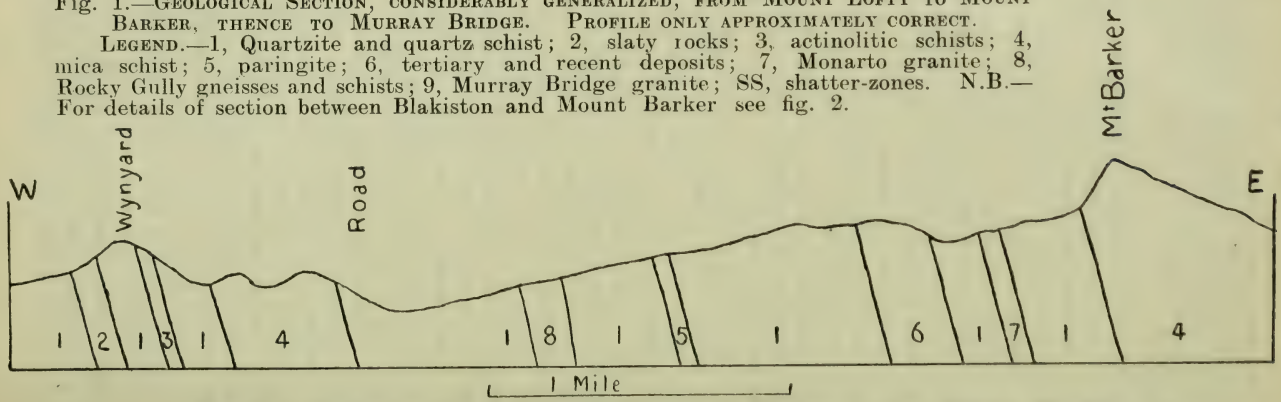

Fig. 2.—Geological Section from Wynyard, Blakiston, to Mount Barker.

Legend.—1, Mica schist; 2, actinolite schist; 3, purple "soapstone"; 4, quartzite; 5, black mica schist, with large white spots; 6, paringite; 7, pegmatite; 8, horizon of Mount Barker marble, which appears *in situ*, in lenticular mass, a short distance to the south of the actual line of section.

that described above (p. 122). It is to be noted that a similar rock occurs in a railway cutting between Balhannah and Ambleside. We cannot at present correlate these occurrences. It is quite possible that they are quite independent, but the lithological characters are so peculiar and so strikingly similar that they are worthy of careful study. Two other exposures which should be compared with those above noted are, the steep bluff forming the right bank of the Onkaparinga close to Ambleside Station, and the long road cutting about a mile from Forest Range, on the Lobethal road. Typical mica schists continue for some distance past Dawesley. About a mile past the bridge over Scott's Creek, and just past a little chapel on top of the hill, there is another splendid exposure of paringite. This must be directly connected with the exposure at the type locality on the railway line (p. 123). The connection has not been mapped in.

From this point to Callington the road traverses the schists in a direction not departing widely from their strike; the variety of rock types is, therefore, not great. There is a general tendency towards increasing metamorphism, with extensive development of muscovite. This mineral is often in porphyritic crystals lying across the schistosity.

Shortly after passing Kanmantoo a very perfect S-shaped fold is visible on the hill slope, about a quarter of a mile west of the road. Close to Callington the schists are much shattered and injected with quartz veins. Some of these veins are slightly felspathic, showing that they represent the limiting members of a series of pegmatite dykes.

From Callington to Murray Bridge the road follows the railway line so closely that there is practically no difference between the sections they reveal. The width of the Monarto granite belt is practically the same on the road as it is on the railway.

On the right bank of the river at Murray Bridge a few outcrops of granite occur. This rock is quite different in character from the Monarto granite. It has not been sectioned, as all the exposures are too rotten. The rock is reddish in colour, more coarsely crystalline, and much more gneissic in texture than the Monarto rock. It contains fairly large pink phenocrysts of orthoclase.

Another very instructive road section is seen between Callington and Mount Barker Town, *via* the Bremer road. For the first four and a half miles from Callington the road (to Strathalbyn) following the Bremer River runs practically along the strike of the beds, so that very little variety is met with. Muscovite schists, like those noted above, are the chief types. It is extremely difficult to obtain readings

of dip, on account of the cleavage and fissility which the rocks display. In one case the planes of dip and fissility slope westerly, and that of the cleavage easterly, all at high angles.

At four and a half miles south of Callington the road to Mount Barker leaves the Strathalbyn road and turns west, so that the strike of the bed is once more crossed. Considerable variety is seen amongst the schists, including white and grey friable muscovite schists, and very tough, black biotite schists. In all these beds the dip is generally a little south of east, at angles varying from 65 deg. to as little as 32 deg.

On the west these pass into white quartzites, which, however, make nothing like so strong a feature as the Mount Barker mass. These quartzites in colour and texture are more like a rock from Tanunda [3] (given me by my colleague, Mr. Howchin) than any other I have met with in South Australia.

This lithological resemblance is not an accident, but is a very important clue (see p. 131).

West of the quartzite band, and about a mile east of the little hamlet of Morning Star,[4] a very strong outcrop of paringite occurs; this lies between the occurrences at Mount Barker and at Gemmel's Station. Just west of the village is a strong development of marble. It is very coarse in grain, and has all the appearance of the Angaston marble (see also p. 131). From the marble quarry to Mount Barker town there is very little conspicuous outcrop of rock. The soil suggests much soft black schist, and I have noted "ferruginous slate." It is probable that this is really the very persistent and important band of purplish "soapstone," which will be described later. I failed to recognize it at the time.

Between Mount Barker town and Echunga there is a series of mottled purplish schists, interspersed with thin-bedded quartzites, which give rise to a very pronounced feature. There is plentiful evidence of heavy earth movement in this area, and it appears to be a definite shatter-zone. West of the quartzite belt we meet with soft schists, in which appear spots suggestive of development of incipient andalusite crystals. These continue to the town of Echunga.

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[3] Trans. Roy. Soc., S.A., vol. xxviii. (1904), p. 203.

[4] I am a little uncertain as to exact distances at this part of my journey, as my pencil notes are very indistinct. It is possible that the hamlet is Wistow, and not Morning Star. The outcrop of paringite shown on the map may be a good deal out of place.

West of the township, on the bush road to the Echunga diggings, there occurs a rock of facies quite different from any other I have seen in this part of South Australia. It is a coarse quartzose grit, strongly cemented with silica. At first sight it recalls some varieties of the desert sandstone met with in the far northern parts of the State. It forms a thin capping unconformable on the upturned edges of the schistose rocks, and by differential weathering gives rise to a steep, though not high, escarpment. The change from schist to grit is very strongly marked by the vegetation, which upon the latter is characterized by abundance of grass-tree. It is possible that this grit may be an outlier of upland miocene.

From Echunga to Macclesfield the road cuts obliquely across the strike of the beds, and shows a section somewhat similar to that between Mount Barker and Echunga. For the first three miles the rocks are soft, sandy schists, which give very little surface outcrop. At this point a belt of soft, shaly, mottled soapstone occurs, similar to rocks at Nairne, Blakiston, and west of Mount Barker town, and, like the former two at any rate, used as a building stone. Just west of Macclesfield is a strong belt of quartzite, very like the rocks just west of Mount Barker town and others between Blakiston and Mount Barker. East of Macclesfield is a broad belt of grey sandy mica schist, followed by alternate tough and friable schists. Some of these contain knots of andalusite, though the latter is nowhere so strongly developed as in the typical paringite. Mica schists of the same general character continue all the way to Strathalbyn. Most of the dips measured along this section are in directions between east and south-east, and at angles which in contrast with those generally obtained in the district are low, averaging between 45 deg. and 50 deg. Along the railway line, Gemmel's to Bugle Ranges, there is a great exposure of paringite, alternating with schists, which have not the large phenocrysts of andalusite, this being the most southerly locality at which I have observed thoroughly typical paringite.

The sections described so far have all been of considerable extent, and only the broad features of them have been given. An extremely interesting and very important section between Blakiston and Mount Barker has been examined in considerably more detail, though even here much remains to be done. Many of the points of resemblance to other sections did not strike me until I began to work up my results recently.

Fig. 2 represents this section.

On the west, between Blakiston Church and "Wynyard," the residence of Rev. J. Gower, the rocks are actinolite schists of various types. The knoll upon which Wynyard stands is composed of the purplish rock which I have elsewhere designated soapstone, and has furnished the building stone for the house. Exactly similar rock, also used as a building stone, occurs about half a mile south of Nairne Station. We then have a series of solid quartzites, which make strong outcrops. These give place to soft, very dark schists, which have worn down to form the bed of the creek. On the actual line of section there is no sign of marble, but less than a mile to the south there is a very strong outcrop of very coarse crystalline limestone like that of Angaston. I have, therefore, included it in the section. East of the limestone belt we have dark schists in which light spots begin to appear. These spots increase in size and abundance, and the rock passes into typical paringite. Intruded along the bedding planes of these schists is a narrow dyke or sill of coarse pegmatite. Eastward the paringite gives place to a great thickness of quartzites. These are for the most part flaggy in structure, though the huge mass of Mount Barker is as solid as the great belt of quartzite at Mitcham and Burnside, near Adelaide.

Summary of Geological Descriptions.—East of the Onkaparinga there exists an immense thickness of crystalline schists of a variety of types. These have pretty uniformly high dips between east or south-east, and there are few instances of reversal of these dips. These facts led Professor Tate to the conclusion that the schists formed the upper portion of a continuous series many thousands of feet in thickness, and building the Mount Lofty Ranges. Their age he believed to be pre-Cambrian. It has been shown by Mr. Howchin that the western part of this series is lower Cambrian, and the same observer has proved the existence of a basal conglomerate to this system resting unconformably on pre-Cambrian rocks near Aldgate and other places. The general conformity in dip throughout the Mount Lofty Ranges is very misleading.

The rocks of the schist series east of the Onkaparinga are lithologically much more highly metamorphosed than those of the lower Cambrian, and though stratigraphical data are, as yet, incomplete, there is little doubt that Professor Tate was right in classing them as pre-Cambrian.

It is probable that they do not form a continuous series for the whole distance, some thirty miles, between the Onkaparinga and the Murray, but that the beds have been repeated by strike faulting and by heavy folding. Certain

shatter-zones have been indicated in this paper. The reason why the folding, if such occurs, is not obvious, and does not cause reversal of dips, is probably that the movements have been so intense that the anticlines and synclines have been overfolded and converted into a series of isoclines.

To decipher the structure in a region of such complexity as this it is absolutely essential to recognize persistent horizons and to map such horizons out in detail.

I claim to have discovered several such persistent horizons: —

(i.) The remarkable knoten-schiefer, which I have called "paringite," has been observed at so many isolated points along approximately the same line of strike that its value as a persistent horizon is practically demonstrated. It makes a good surface outcrop, which should be easily followed.

(ii.) The associated crystalline limestone appears to occur only in lenticular beds of considerable extent, but, nevertheless, should prove to be a valuable horizon for mapping purposes. An outcrop of it occurs at Bull's Creek.

(iii.) The purplish rock which, for want of a better name, I have called "soapstone," appears to be persistent. I know of several places where it occurs, and is used as a building stone.

(iv.) The white saccharoidal quartzite described on page 128 may be found of value.

(v.) The belt of tremolite and actinolite schists typically developed west of Mount Barker Junction is characteristic, but yields little surface outcrop.

It is to be noted that *all the above horizons occur in the Angaston district, forty miles to the north of Blakiston, in the same relative positions as they occur at Blakiston, showing their remarkable persistence, and indicating their extreme value as stratigraphical landmarks.*

Suggestions to Future Observers.—I may perhaps be permitted to make a few suggestions which will enable future observers to save some time in preliminary investigations. I think the Blakiston to Mount Barker (mount) section should be carefully studied, and the area just to the north and south of it. I believe this section will afford the key to very much of the geology of the district. I then suggest that the observer become familiar with the paringite in some of its typical occurrences, and then systematically map this important formation. In doing so many other problems will be suggested.

I think it likely that the valley in which Mount Barker town lies is the axis of an important fold; the sections from Mount Barker town to Echunga, and from Echunga to Mac-

clesfield, appear to be somewhat similar to the Blakiston section, but in reverse order.

Finally, I beg to suggest that the immense series of rocks of, almost certainly, pre-Cambrian age, should receive a distinctive name. Mr. Howchin has used the name Mount Lofty series for the lower Cambrian rocks to the west of the range, and I propose that the rocks described in the present paper be grouped as the Barossa series (or "Barossian"), from their extensive development in the Barossa Ranges. Some such name will, I feel sure, be found necessary in dealing with the enormous mass of pre-Cambrian rocks in South Australia. I am fairly familiar with rocks of this group in other parts of the State, and, on lithological grounds, I am persuaded that it will be necessary to recognize at least three included series represented respectively by the basement complex rocks of Eyre Peninsula and the islands of Spencer Gulf, by the series in Yorke Peninsula typically developed at Ardrossan, and by the rocks I have termed Barossian.

Petrographical Descriptions of some of the more important Rock Types.

Rocky Gully, between Monarto and Murray Bridge. *Hornblendic gneiss*, completely granular, with very uniform grainsize, about ·25 mm. on an average. Texture thoroughly schistose (hornoblastic). Quartz is the most abundant mineral present in rounded and ovoid grains. These are full of little circular flakes of biotite and very numerous liquid and gas inclusions. These cavities are very irregular in shape, and some are comparatively large in size; some of them have "spirit-level bubbles," others have bubbles showing spontaneous movement.

There is a good deal of albite in perfectly round grains. Most of it is untwinned, but some shows twinning after albite, carlsbad, and pericline laws. Measurements show it to be an almost pure albite. In addition to the albite there is some orthoclase distinguished by its refractive index. Owing to the absence of twinning in much of the albite, it is difficult to estimate the relative abundance of the felspars accurately; the albite is certainly predominant. Both felspars are clear of inclusions. Biotite flakes are fairly abundant, and have very marked parallel orientation. They are intergrown with muscovite, and contain inclusions of magnetite. There is a little muscovite, mostly intergrown with biotite, but partly independent also. Some of the latter is developed across the schistosity of the rock.

Hornblende is not abundant, but occurs in largish, irregular flakes developed across the schistosity, and containing inclusions of all the other minerals.

There is a little zircon, sphene, and rutile in small crystals and grains.

There are a few curious pseudomorphs present. These are square in cross section, and consist of a fibrous brownish aggregate of radiating fibres with weak double refraction. Their size is very minute, and I have not been able to determine the mineral. In another specimen from the same locality hornblende is somewhat more abundant.

Rocky Gully. *Biotite gneiss.*—In general characters very like the rock described above. It has no hornblende. In addition to albite and orthoclase, a small amount of anorthoclase is present. Biotite is partly bleached to a light bluish green material, which is almost uniaxial. This bleaching is accompanied by the separation of brilliant golden yellow webs of "sagenite," or of beautiful little six-rayed rosettes of the same material. Sometimes these rosettes are arranged on an axis, the whole very strikingly resembling in shape a Norfolk Island pine. There is also a good deal of orange-red primary rutile present. Some of the iron ore is ilmenite, and is decomposing into or intergrown with rutile.

Rocky Gully. *Pegmatite.*—Rock is coarse in grain, and consists essentially of quartz and felspars.

Quartz is in large grains of irregular shape, some of which show no strain structures, though most have undulous extinction, or are granulated. The quartz contains small gas and liquid inclusions of very minute size. Felspars are remarkable for their variety. Orthoclase, anorthoclase, albite, and oligoclase-albite are all present, and can be distinctly differentiated. They are all rather decomposed, and show a considerable amount of strain. There is a little biotite present in long thin flakes, often bent and broken. It is partly intergrown with muscovite, and partly decomposed into talc.

Muscovite is very subordinate in amount. In addition to that noted above, there are flakes developed as inclusions in the felspars parallel to the zonary lines, indicating traces of potential crystal edges. (Plate ii., fig. 1.)

Rocky Gully. *Pegmatite.*—Very similar to the last one on the whole. Felspar is more abundant than quartz, and a good deal of it shows "moirée" structure. All stages are observed, from perfectly untwinned orthoclase, through orthoclase with slightly undulous extinction (obviously the result of strain) to "moirée mikroklin," and ultimately to "gitter mikroklin" structure. The twinning is always so fine

as to give superpositions within the thickness of the slide, so that measurements cannot be satisfactorily made. This felspar is granophyrically intergrown with quartz.

Oligoclase is also present in fairly idiomorphic crystals which show no sign of mechanical strain. Round the edges of some of the oligoclase crystals there is a pegmatitic intergrowth with quartz.

Quartz grains are fairly large. All show strain effects from undulous extinction to complete shattering.

Biotite present in small amount, pleochroism from dark-green-brown to yellow, shows dark halos round included zircon. Muscovite very scarce.

A little apatite is scattered through the rock.

Railway line between Callington and Monarto, at the forty-eight mile post. *Biotite schist.* Perfectly granular with very fine grainsize. Thoroughly schistose. Light and dark constituents about equally abundant. The former include chiefly quartz and acid felspar. Recrystallization is complete, and there is no trace of undulous extinction. The felspar is almost entirely untwinned.

The dark-coloured material is chiefly biotite of a clove-brown colour.

There is a notable amount of muscovite present in largish flakes whose lengths lie across the schistosity.

As accessory minerals we have a little tourmaline with pleochroism colourless to brown, and a little zoisite in rounded grains. No garnet is to be seen.

Near Kanmantoo. *Biotite schist.*—Finely granular and completely schistose. Quartz and biotite are the most abundant constituents, the latter being dark-brown. A little untwinned acid felspar is present, but much less than in any of the other rocks so far described. There are grains and flakes of magnetite and a few microscopic garnets; also an occasional prism of rutile. A fair amount of muscovite is present in porphyritic flakes lying across the schistosity and containing ovules of quartz.

First Railway Cutting west of Callington. *Chlorite schist.*—The texture is markedly porphyritic, the grainsize of the base being uniform and fine (about ·025 mm.).

There is no felspar discernible in the base, which is essentially composed of thoroughly granular quartz and brown biotite, with subordinate amounts of muscovite and ilmenite. Biotite and ilmenite both have extremely minute orange webs and rosettes of "sagenite" like those above described (p. 133), but on a much finer scale. There is a little tourmaline and a fair amount of rutile also. The rock is rendered porphyritic by clinochlore in irregular flakes up to about 1·5 mm. across

by about ·5 mm. thick. This mineral is light greasy green in colour, with pleochroism from light bluish-green to darker green. There are abundant very minute inclusions (zircon ?), round which are dark halos. The optical character is almost uniaxial and positive. In vertical sections twinning is seen, giving symmetrical extinctions of 5½ deg. The flakes lie across the schistosity at irregular angles, and contain much of the groundmass.

Another very peculiar feature of the rock is the occurrence of pseudomorphs of light-coloured materials. The original mineral was porphyritic, and slightly larger than the chlorite. It was probably andalusite, as we encounter this mineral very strongly developed a short distance to the west of the present locality. The material composing the pseudomorphs is a granular mixture of about two-thirds muscovite and one-third quartz. They contain very little biotite and magnetite. In shape they are lozenge-shaped and distorted. (Plate ii., fig. 2.)

Between Callington and Paringa.—The rock in hand specimen is silvery and lustrous, perfectly fissile, and shows abundant small dark spots in a fine groundmass. Round these "knots" the groundmass exhibits flow structure.

Under the microscope the rock is found to consist of about equal proportions of fine groundmass and porphyritic aggregates. The groundmass is composed chiefly of light-brown biotite, in flakes about ·004 mm. in average diameter, and quartz of about the same order of size. A little muscovite and tables of ilmenite are present.

The aggregates, which in hand specimen appear like porphyritic crystals, are found to vary considerably in character. Some appear as ovoid areas very ill-defined, and are distinguished from the groundmass by their lighter colour. The minerals composing such an aggregate are quartz muscovite, biotite, ilmenite, and dark chlorite in grains and flakes, with average dimensions of about ·05 mm. The light-coloured constituents are more abundant than the dark, and in the better defined aggregates make up fully 90 per cent. of the material. There is no trace of parallel arrangement of the plates in some of the aggregates, but in most of them the muscovite tables have their large surfaces parallel to the plane of schistosity of the rock. Between crossed nicols these aggregates are much more conspicuous than in ordinary light, owing to the contrast between the polarization colours of quartz and biotite.

Other aggregates are in the form of fairly well-defined polygonal areas, more or less distorted, in which the minerals are clear muscovite and dark-green chlorite in large flakes.

Individual flakes may be as much as 1 mm. by ·5 mm. Ilmenite in small grains is scattered through the aggregates just as it is through the groundmass. In these chlorite-muscovite aggregates the chlorite is usually central, and the muscovite peripheral, though there is a good deal of mutual penetration.

Between the two extreme types of aggregates described above there are numerous transitional types in which the grainsize is intermediate between the limits given, and the amount of quartz and biotite varies also. The aggregates run up to about 2 mm. diameter.

In addition to these aggregates there are also some independent porphyritic crystals of clinochlore about ·4 mm. by ·05 mm. These possess characters exactly similar to those described in the preceding rock. (Plate ii., fig. 3.)

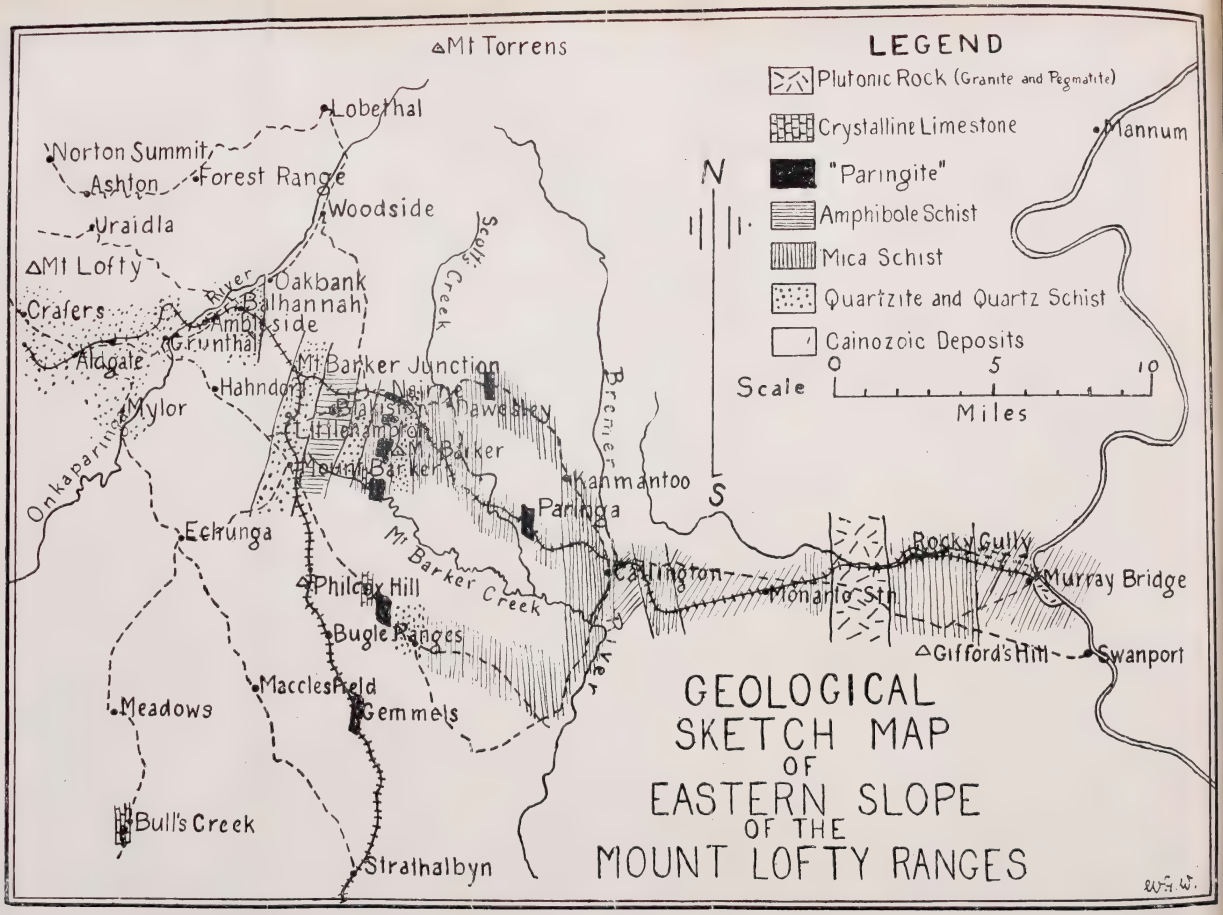
Wynyard, Blakiston. *Scapolite amphibolite.*—The rock consists essentially of actinolite and scapolite. The structure answers admirably to the description of *poikiloblastic structure* given by Grubermann.

Actinolite is the most abundant constituent. At first sight it appears to be irregularly scattered about in stumpy rods, here and there aggregated into masses. The masses are, however, crystal grains, and the surrounding rods are in optical continuity with them. The optical orientations of adjacent areas are quite independent, and are in no way determined by the schistosity of the rock.

The scapolite is perfectly colourless, and forms a base in which the actinolite is scattered. It is optically continuous over wide areas whose boundaries are extremely irregular. The refractive index is notably greater than that of Canada balsam, and the double refraction quite strong. The mineral is uniaxial and negative. There is little trace of cleavage, and the mineral is remarkably fresh. In places there is a tendency towards fibrous structure, probably pointing to incipient decomposition. Adjacent fibres show marked differences of double refraction. When the lengths of the fibres are parallel to the plane of vibration of the light no Becke's effect is noticeable between them, but when they are rotated through a right angle marked differences of refractive index are apparent.

Biotite pleochroic in red-brown to light yellow tints is abundant locally through the rock. There is plenty of greyish sphene in small fusiform grains. Fine iron ore is scattered through the rock, particularly in the actinolite.

Wynyard, Blakiston. (This rock and the preceding one are from a well.) *Amphibolite.*—The rock is somewhat



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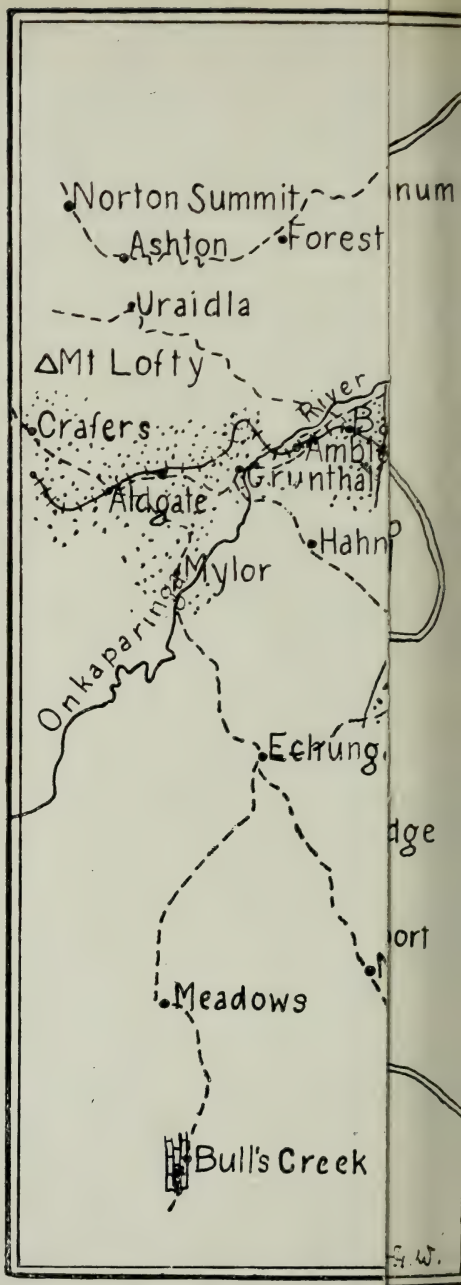
Norton Summit
Ashton
Forest
Uraidla
Mt Lofty
River
Crafers
Aldgate
Grunthal
Hahn
Mylor
Onkaparinga
Eckung
Meadows
Bull's Creek

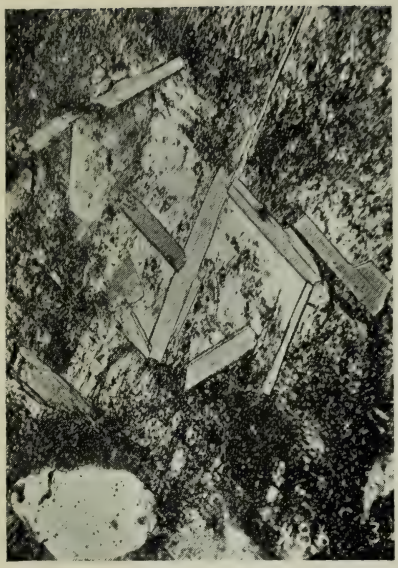

FIG. 1.

FIG. 2.

FIG. 3.

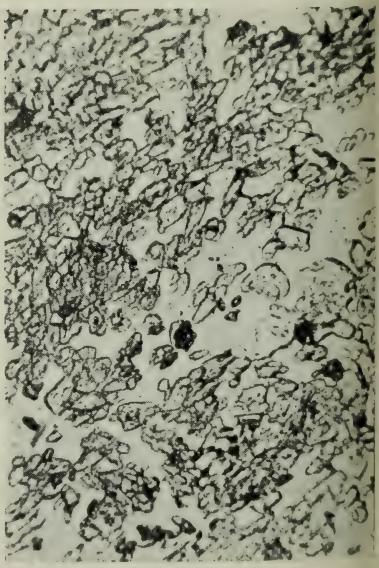

FIG. 4.

Hussey & Gillingham, Printers, Adelaide.

similar to that last described, but lacks the diablastic structure. In this rock the structure is porphyroblastic.

The constituent minerals are abundant light green actinolite, and felspar, sphene, vesuvianite, magnetite, and decomposition products.

Light green actinolite makes up about 75 per cent. of the rock. It occurs in idioblasts, about ·2 mm. in diameter, with strong suggestions of crystallographic boundaries in the vertical zone. The pleochroism is weak from colourless to light green, extinction on (010) is 19 deg., and the optic axial angle is not far from a right angle.

About 23 per cent. of the rock is felspar. This is mostly in untwinned rounded grains, about ·02 mm. in diameter. An occasional fragment of plagioclase of larger dimensions occurs. The untwinned felspar is probably near oligoclase in composition, as its refractive index is scarcely to be distinguished from that of balsam. The mineral is not quartz, as it is biaxial and decomposed. I have not been able to recognize any quartz at all in the rock. The borders of the felspar grains show much alteration into an opaque greyish fibrous mass. Under higher powers this is resolved into fine fibres with weak double refraction strongly suggestive of zoisite.

Sphene in dark orange-brown irregular grains makes up the bulk of the remaining 20 per cent. of the rock.

A few grains of vesuvianite occur of light brownish colour, the colour being somewhat irregular in its distribution. They show no trace of crystal form.

A very few grains of magnetite, slightly decomposed to hæmatite, occur. (Plate ii., fig. 4.)

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DESCRIPTION OF THE PLATES.

Plate I.—Geological sketch map of the area described in the paper. Geological traverses have not been run, so that boundaries are only sketched to show approximate positions. No attempt has been made to differentiate the various mica schists.

Plate II., fig. 1.—Orthoclase felspar in pegmatite, Rocky Gully, Murray Bridge, showing inclusions (flakes of muscovite) arranged parrallel to crystal planes of the host. ×60 diameters.

Plate II., fig. 2.—Porphyroblastic chlorite schist, near Callington, showing large crystals of clinochlore arranged across the schistosity of the rock, and light pseudomorphs parallel to the schistosity. ×16 diameters.

Plate II., fig. 3.—Porphyroblastic mica schist, near Callington, showing general structure of rock. ×16 diameters.

Plate II., fig. 4.—Amphibolite, Blakiston, showing poikiloblastic structure. ×86 diameters.

Notes on Some Species of the Isopod Family Sphæromidæ, from the South Australian Coast.

By W. H. Baker, F.L.S.

[Read June 7, 1908.]

Plates III. to X.

In presenting these notes I must acknowledge the great assistance I have had from Dr. Hansen's paper entitled "The Propagation, Structure, and Classification of the Family Sphæromidæ," in the "Quarterly Journal of Microscopic Science," n. series, vol. 49, pt. 1, 1905. Without it it would have been quite impossible for me to treat with any degree of success species of this acknowledged difficult family which have come under my notice from our coast. At the same time it will be seen that my observations do not quite agree with statements in Dr. Hansen's paper regarding the parts occupied by the developing young in some genera.

In studying the species of this family, the thing that strikes one most is their great variability—this, indeed, is the main cause of the confusion which has held sway in their classification so long; but a general statement may be made, namely, that the young of both sexes resemble each other, the deviation occurring in adult males and females; that of the young-bearing females of many genera has been shown by Dr. Hansen in the above-mentioned paper. As an instance with the males, to take the case of *Cymodoce tuberculosa*, Stebbing. In this species there are two conspicuous processes on the anterior division of the pleon which are not figured or mentioned by the author or by Mr. Whitelegge, who refers at length to the same species from New South Wales; the inference, of course, is that they were not present in the specimens examined by them, athough Mr. Whitelegge speaks of his as being adult males. Another instance will be seen in the case of *Cilicæa curtispina*, Haswell, later on.

With regard to the young-bearing females, whose mouth parts and viscera have been so much altered, one fails to see how the animal recovers itself after rearing a brood, and is driven to the conclusion that the individual perishes in the effort, and is probably, in some cases at least, perhaps eaten by the brood. In the female of a species of *Cymodoce* which, as yet, I have not been able to identify, I have observed the transverse slits in the sternal plates referred to by Dr. Hansen, and have seen well-formed young emerge from under the marsupial plates; these were somewhat har-

dened. The young ready to emerge from the body through the slits are very soft, and can consequently squeeze through a small space; the slits, however, in this species are large.

The following descriptions are from the male in each case, except where otherwise stated.

Family SPHÆROMIDÆ.

Subfamily SPHÆROMINÆ.

Group HEMIBRANCHIATÆ, Hansen.

Genus *Cymodoce*, Leach.

Cymodoce longicaudata, n. sp.

Plate iii., figs. 1 to 11.

The body is little convex, the tendency to curl up much reduced, becoming slightly narrow towards the head.

The head is arcuate in front, and considerably longer than the first thoracic segment. The eyes are large, prominent, and wedge-shaped. There is a median rostral projection, which is rather large and terminally obtuse.

The first thoracic segment is rather shorter than those which follow, the rest are short and subequal in length. The epimera, except the ones belonging to the last segment of the thorax, project laterally, and are very conspicuous viewed from above. They are sickle-shaped backward and very acute, and are all—except the first—marked off from their respective segments by distinct sutural lines. The last segment has epimera rounded and scarcely projecting.

Four fused segments are indicated on the anterior portion of the pleon; the first terminates laterally under the side of the preceding segment; the second has an acute lateral projection, similar to those of the thoracic segments; the fourth has the median portion of the posterior margin slightly arcuate, with the usual notch on each side. The terminal segment of the pleon is dome-shaped, and has an acute lateral projection; behind this the surface is strongly depressed until the basal portion of the median posterior spine is reached. The posterior notch is bounded by two acute projections, with the median spiniform process large and reaching much beyond them; this process is dorsally carinate and very acute.

The epistome is well developed; its lateral limbs are subacute.

The rather large basal joint of the antennule has the anterior side of the distal notch scarcely produced, but on the posterior side the projection is very acute, curved, and reaches nearly to the end of the second joint, as in *Circeis*. The second joint is more than half the length of the first

to the base of notch of the first; it is distally obliquely truncated, and has below a very prominent and acute keel. The third joint is very slender, and shorter than the second, and is articulated to it in a small cavity. The slender flagellum has about 24 joints. The flagellum of the antenna has from 26-32 joints.

In the right mandible the spine row is well developed, consisting of 7-8 coarsely pectinate spines; a small tubercle faintly toothed lies between these and the molar tubercle, which is well developed; the incisory plate is distally entire. The left mandible has a secondary plate divided into three teeth. The first two joints of the palp are subequal in length.

The maxillæ and maxillipeds are of the usual type. The lobes of the palp of the maxillipeds are long, with their setæ well developed.

The first gnathopods are robust, the basis subequal in length to the two following joints, taken together, the fourth, fifth, and sixth joints are posteriorly spined. The dactylus is rather long, robust, and two-clawed. The legs following the first pair are sparely spined; the pads, so much in evidence in other species of this family, are here represented by soft plumose setæ.

The sternal filaments of the male are rather long. The *appendix masculina* is longer than the ramus which bears it, and is very slender. The exopods of the third, fourth, and fifth pleopods have each a division; a few distal setæ are on the exopods of the fourth pleopods.

The uropods are long and slender; the peduncle has a small spine below the insertion of the outer ramus; the outer ramus is narrow lanceolate, and reaches beyond the inner ramus; the inner ramus is also narrow, carinate below, with the inner margin slightly curved, reaching beyond the terminal spine of the pleon. The margins of the uropods and pleon are sparingly clothed with very short hairs.

The female does not differ from the male in any noteworthy respect, except, of course, when bearing young; then the mouth parts and viscera are modified in the usual way. In what appears to be an old female there are no ova or young, but there are the remains of marsupial plates; the viscera seem to have disappeared, as the sternites are sunken in or wanting; the pleopods, however, are intact.

Cymodoce tuberculosa, Stebbing.

Plate iii., figs. 12 to 15.

The epistome has two projecting teeth transversely placed on the anterior portion, similar to the rostral teeth, and inclined to be bifid.

There are five teeth on the anterior border of the first peduncular joint of the antennule, with a sixth smaller outermost.

The posterior notch of the pleon is wide and deep.

The male has two prominent posterior projections on the anterior portion of the pleon.

The internal ramus of the uropod has three terminal teeth, one larger above, two below. The external ramus is shorter and narrower, with two terminal teeth.

The body is minutely pubescent, but the hairs are coarser on the pleon and uropods.

The female of this species has not been identified.

Cymodoce hamata, n. sp.

Plate iv., figs. 1 to 11.

Body moderately convex, covered with a furry tomentum, which entangles much foreign matter, with longer scattered hairs. It is conspicuously contracted at the seventh thoracic segment.

The head is evenly rounded and anteriorly very obtuse, with two very obscure median projections. The eyes are prominent and subcircular.

The first segment of the thorax is about as long as any two together of those which follow; these are narrow, prominent, and scarcely differ in length. The epimera slightly project outwards; their lower outline, taken together, is very irregular, the individual apices being more or less obtuse; that of the seventh segment is much shorter than the rest.

The sides of the anterior part of the pleon project downwards, much in contrast to that of the seventh thoracic segment, but the antero-lateral angle is subacute; this portion of the pleon bears one small tubercle each side of the median line, whilst the posterior portion has also two tubercles, which are more or less spiniform, and situated on a dome, which is granular; between these two tubercles is a longitudinal depression. The posterior notch is wide, with a strong median process, which projects beyond the sides, is obtuse, and slightly turned up or tuberculate at its end.

The basal antennular joint is large, about twice as long as broad, with the distal notch shallow. There is a small keel on the underside of the second joint. The flagellum has 11 joints.

The flagellum of the antenna has 16 joints.

The epistome is slightly lobulate, the upper lip externally convex.

The maxillipeds have the plate of the second joint shorter than the joint itself, with the distal spines well deve-

loped, several of them strongly pectinate; the coupling spine is rather near the end. The lobes of the palp are long.

The legs are of the usual type, and spiniform.

In the first and second pleopods the exopods are areolate, or apparently covered with scale-like markings. The *appendix masculina* is thick and concave, or semi-cylindrical for its whole length. The exopods of pleopods three, four, and five have divisions; that of the fifth has two lobes on the distal end, and two at the inner side on the angle of the proximal division.

The uropods have a short inner ramus, the end of which is subacute, and projects backwards, it does not nearly reach the notch. The external ramus is long, cylindrical, curved, and ends in a recurved hook, with two or more less curved.

In a female, whose mouth parts are modified in the usual way, the size is the same as that of the male; the more posterior segments of the thorax are very short. The posterior notch of the pleon is roofed over by a process which projects far behind, and is turned up at the end and bifid. The uropods are weaker than in the male, the inner rami more acute, the outer more hooked.

In an unmodified female which I have figured the external rami of the uropods are very strongly hooked, there being three other curved spines on each. The inner ramus is very acute. The legs are rather slenderer than in the male.

In both sexes the limbs are dotted with black spots.

South Australian coast, found in sponges.

Genus *Cilicœa*, Leach.

Cilicæa curtispina, Haswell.

Plate iv., figs. 12 to 17; and plate v., figs. 1 to 8.

The body is strongly convex, smooth, with areolate markings; glabrous, with one or two lateral tubercles on each side of the sixth and seventh segments of the thorax. Obscure tubercles are also indicated on the posterior margins of more of the segments in some males.

The head is evenly rounded anteriorly, the margin being slightly thickened; it is narrower than the first segment of the thorax, and more than twice as long. The rostral portion is broad and distally truncated, meeting the anterior part of the epistome by a transverse sutural line.

The segments of the thorax are short, and do not differ much in length. The epimera are nearly vertical in direction, somewhat sculptured, and at their junctions, with their respective segments, are raised, forming an interrupted longitudinal ridge, which also is marked on the first seg-

ment; the individual plates approach gradually to the quadrate shape behind; that of the first segment projects behind and before to an equal degree, and is deeper than the others; that of the seventh is not so deep as the others. The plates, being slightly excavate, show ridges on the free margins.

The sides of the anterior portion of the pleon show three faint lines crowded together, marking coalesced segments; this portion is deeper than the epimera of the thorax, and its anterior border carries a small tooth-like projection, usually hidden by the last plate of the thorax. Posteriorly there is a large median projection, which is vertically compressed, and far exceeds the end of the pleon; its end is obtuse and rounded. The posterior portion of the pleon bears a conical tubercle on each side of the median projection of the anterior part, with two or three small granules above each, and its antero-lateral parts have oblique ridges extending to the insertions of the uropods. The posterior notch is vertically excavated, moderately deep, its roof projecting behind very slightly, and there is only the faintest indication of three teeth on this.

The first joint of the antennular peduncle is about three times longer than broad; its distal end has two projections, the posterior one projecting outwards, the anterior upwards. The second joint, which reaches out to the level of the anterior end of the eye, is about one-third the length of the first, and is distally bifid and ridged above and below; the third joint, which is considerably narrower, is cylindrical, and is articulated under the bifid projection of the second. The flagellum has 15 or 16 joints.

The antenna has the last two joints of the peduncle subequal in length; the flagellum is not much longer than the peduncle, and consists of 18 short joints.

The mandibles are massive, without dark tips to the incisory plates, and with no distinct division into incisory plates and molars, and there are no secondary plates or spine rows. The palp is rather feeble.

The spines on the outer branch of the first maxillæ are dark.

The second maxillæ are narrow, all the lobes reaching the same distance.

In the maxillipeds the distal end of the plate of the second joint is sparingly setose; the lobes of the palp are long.

The legs are rather slender.

In the first gnathopods the ischium is shorter than the basis; the merus, carpus, and propodus are spined in the

usual manner, and together they are subequal in length to the ischium.

In the second gnathopods the basis and ischium are subequal in length, the merus a little longer than the carpus, the propodus longer than the carpus. The spines on this limb and three following pairs are mostly replaced by furry pads.

The first pleopod has the inner margin of the endopod folded at right angles to the other part, as shown in the figure. In the second pleopod the *appendix masculina* reaches farther than the fringe of the endopod, and there is also a less pronounced fold on the inner margin. The proximal end of the *appendix* is bent down quite to the base of the peduncle, as is seen in *C. latreillii*. The exopod of the third pleopods has a division; its endopod has some curious minute crowded teeth on the inner margin; its external distal angle is abrupt. The exopod of the fifth pleopods has six denticulate lobes, four of which are on the distal division.

The two sternal filaments are long.

The uropods have the internal ramus much reduced; the outer ramus is strong, rounded externally, flattened internally, curved, and slightly bifid at the end, projecting well beyond the dorsal process.

The female differs considerably from the male; in it the anterior portion of the pleon has two short median longitudinal ridges, but no large projection. The posterior portion has, besides the two large conical projections, two small tubercles a short distance above each. The posterior notch is deeper than in the male, and has a roofing projection more or less tridentate at its apex.

The inner ramus of the uropod is bifid at its apex; the outer ramus also is bifid, with an external projection, and an inferior keel terminating abruptly short of the bifid end. The inner uropod is channelled to receive part of the outer one when folded.

Sometimes none of the ambulatory legs are padded.

In the specimen examined the marsupial plates were well developed and overlapping; the mouth parts were modified, although the external appearance of the mandibles closely resembled those of the male.

A young female, which I take to be a variety of this species, has the following distinctions:—The posterior segments of the thorax are narrower, and all are more or less provided with small tubercles arranged transversely. The two ridges on the anterior part of the pleon are more converging behind. There are more small tubercles above the

larger projections on the posterior portion. There is a large tubercle above the uropods. The posterior prolongation which roofs the notch is strongly tridentate, and a small median tubercle is just above it. The ridge formed by the upper parts of the epimera of the thorax is more pronounced. There is a conical tubercle on the underside of the peduncle of the uropod.

A common species.

Group Eubranchiatæ, Hansen.

Genus *Dynamene*, Leach.

Dynamene ramuscula, n. sp.

Plate v., figs. 9 to 20.

The body is strongly convex, rather narrow, covered sparely with long, harsh hairs, which are more numerous on the pleon and uropods.

The head is a little longer than the first segment of the thorax, convex, and rather abruptly declivous anteriorly.

The first segment of the thorax is declivous anteriorly, and is longer than either of the four which follow, but not so long as the sixth, which bears two posteriorly projecting processes, which reach nearly as far as the end of the pleon; each of these processes has a slightly sinuous shape and a small branch near the end, which projects downwards. The apices of the epimera are nearly in the same curve, and are without distinct sutural lines marking them off from their respective segments. The seventh segment of the thorax is short, and its small epimera fall short of the preceding ones. The anterior portion of the pleon is only distinctly indicated at the sides, where its anterior angles are nearly right angles. The posterior portion of the pleon is convex, rough, and hairy, having five tubercles; one large median is obscurely cleft apically, two lateral on each side, the more anterior pair larger and nearer the middle; there is also a low tubercle just above the insertion of each uropod. Behind the median tubercle the surface descends abruptly to the posterior notch, which is situated on a conical projection, is a circular foramen with the inferior slit quite closed for its whole length underneath, and showing a very slight median projection behind at the extremity.

The eyes are subcircular.

The antennular peduncle is rather long, projecting distinctly beyond the eyes when raised; the notch on the first joint, which holds the second, is not deep, and inferiorly there is a small projection. The second joint is rather more than half the length of the first, and projects obtusely beyond

the articulation of the third joint; it has also an inferior keel-like projection. The third joint is a little curved; the flagellum consists of about 8 joints, which are longer than those usually met with in other species.

The antennal flagellum has 11 joints.

The maxillipeds are of the usual type, the lobes of the palp rather long, the distal setæ rather short, the last joint is subequal in length to the penultimate, apart from the projecting lobe of that joint.

The second gnathopods and the last pereiopods are subequal in length, and are longer and slenderer than the rest of the legs; the last pair bears irregularly disposed long hairs, as also do the others in a less degree; the spines are poorly developed.

The first pleopod has the endopod much broader than long. The second pleopod is without *appendix masculina*, and in both pairs the fringes of the exopods are very long. In the third pleopods the endopod is much larger than the exopod; the exopod is without division, and its fringe is long. The third pleopods as a whole are larger than the others, including the peduncle.

The external ramus of the uropods is straight and lanceolate, much narrower and longer than the inner ramus, and terminally subacute. The inner ramus is obtuse, and slightly curved outwards.

The female is narrow-ovate in shape, the posterior part of the body being conspicuously narrowed; the legs are much shorter and slenderer than in the male; there are no processes on the sixth segment of the thorax, the posterior notch is an inverted triangular-shaped foramen, almost closed behind. The uropods are subcylindrical and small; the posterior part of the pleon has a low median tubercle.

There are well-developed marsupial plates, and the young, most of which were well advanced in the specimen observed—I counted 50 in somewhat varying degrees of development—occupied the whole of the body cavity, and were seen close beneath the marsupial plates, as well as away back near the dorsum; the body seemed to be reduced to a shell, the viscera having apparently disappeared. The mouth parts were highly modified. A second female had eggs scarcely more advanced than a round or slightly elongated shape would suggest; these showed to be directly under the marsupial plates, and also to occupy the body, as in the other female.

Length of parent, about 5 mm.; that of the largest young, about 1 mm.

Gulf St. Vincent, found on sponges. Three specimens only.

Genus *Amphoroidea*, M. Edw.

Amphoroidea angustata, n. sp.

Plate vi., figs. 1 to 10.

The body is narrow, smooth, moderately convex, with the epimera not distinctly marked off from their respective segments, and are almost vertical in direction. The head is moderately depressed, and is longer than the first segment of the thorax; there is a slight excavation of the margin on each side of a small rostral process. The eyes are rather small and slightly prominent. The first segment of the thorax is rather shorter than the rest, which are subequal in length. The posterior margins of the fourth, fifth, sixth, and seventh project slightly behind in an increasing degree serially. The anterior portion of the pleon shows the median portion of a first segment; the second forms the whole of the lateral portions; the others are obscure. The posterior portion is dome-shaped, tapering behind, with an obtuse rounded end, having a very faint insinuation, representing a notch, scarcely visible from above.

The basal joints of the antennules are expanded into broad sub-lamellar ovate plates, projecting in front of the head, with their inner margins diverging. The second joints are slightly expanded. The third joints much narrower, and short. The flagellum has 7 joints, the two terminal ones very minute.

The antennæ have their third and fourth peduncular joints rather more expanded than usual. The flagellum has 11 joints.

The epistome is large, quite like that in *A. australis*, Dana.

The maxillipeds have the joints of the palp with small lobes sparingly setose.

The legs are in a single series, and—except the first gnathopods—subequal: they are all hairy, and almost devoid of spines. The basal joints are short.

The first gnathopods are somewhat twisted, the basis and ischium are subequal in length, the merus is strong and much broader than long, the carpus is insignificant, the propodus is compressed—being flattened on the inner side—to a narrow posterior edge, which, besides the hairs, has two pectinate spines; the inner surface of the joint also bears short hairs, which are not numerous. The dactylus is strong with a terminal curved claw, and in place of the secondary claw there are three strong teeth close together, followed by a short series of very short teeth inwardly. The dactylus moves at right angles to the plane surface of the propodus.

The second gnathopods are scarcely twisted, and are a little longer than the following legs.

The pleopods are rather narrow. The first pair has the endopod much smaller than the exopod, and is about twice as long as broad; the inner margin is straight and slightly thickened; the outer insinuate, with a small turned-up point near the proximal end. There is a "shelf," on which rests the inner margin of the exopod. The exopod is broadly-ovate. Areolate structure is well marked.

The second pleopods have an elongate endopod nearly twice as long as the exopod. The *appendix masculina* is as long as the lamina; on the lamina is a faint "shelf" on which the appendix rests. The exopod is narrow-ovate, with a much longer fringe than that of the endopod.

The third pleopods are shorter than the second; in them the exopod is shorter and narrower than the endopod, and has a nearly straight inner margin, and is without division

The fourth pleopods have both rami branchial.

The exopod of the fifth pleopods has two lobes at the distal end, and two on the inner margin, one above the other, a short distance; a division is not plain; the external margin is almost devoid of setules.

The uropods are broadly lamellar, ovate, the inner rami projecting beyond the end of the pleon, the outer projecting a little beyond the inner. The outer ramus is a little smaller than the inner.

Gulf St. Vincent, shallow water. One male specimen and two immature.

Amphoroidella, new sub-genus of *Amphoroidea*.

Amphoroidella elliptica, n. sp

Plate vi., figs. 11 to 18.

The body is ovate, convex in both directions above, concave beneath, covered with a kind of skin that can easily be scraped off, the "skin" thrown into a median dorsal fold or thickening, rendering each segment of the thorax apparently tuberculate in the larger specimens. First and second joints of the antennules, segments of the thorax, anterior and posterior divisions of the pleon, with the uropods, much expanded, so that only the head and extremity of the pleon are not concerned in the outline.

Head short, somewhat depressed; anteriorly there is an insinuation each side of a small rostral projection not more developed than is usual.

The lateral expansions of the first thoracic segments approach those of the second joints of the antennules; there is,

however, a much wider gap between these than between any of the other side expansions, the ends of the two uropods excepted. The margins of all the expansions have a dense membrane-like fringe, with projecting hairs. The head and all the segments of the thorax do not differ much in length. The epimera of all except the first are separated by distinct sutures from their respective segments, and project nearly in the same curve as the segments.

The anterior portion of the pleon is short, marked with the usual lines, which do not extend on to the lateral plates, showing probably that only the more anterior segment bears the expansion. The posterior portion of the pleon is convex, and has anteriorly a median low convexity; it tapers quickly to a narrow rounded end, which is without notch, being only channelled below in the faintest manner; the sides and ends are thin.

The third joint of the antennule is of the usual size, the flagellum short, with 8 or 9 joints.

The epistome is arcuate and very distinct, without an anterior prolongation. The upper lip is large.

In the mandibles the molar is much reduced; on the left mandible the spine row and secondary plate are not distinctly differentiated; in the right the spines also are coalesced. The incisory plates of both are well developed and dentate. In the male the mandibles are normal.

The maxillipeds have the lobes of the joints of the palp short, especially that of the penultimate, which is subequal in length to the last. The setæ are rather scanty.

The legs are in a simple series, and all are similar—except the first gnathopods—and do not differ much in size. The carpus of each, except the first, has an insinuation on one side; all are nearly spineless. The dactyli are short, but the principal claw is rather long and acute.

The endopod of the first pleopods is much longer than broad; it has a ridge, or shelf, on which the inner margin of the exopod lies. The exopod of the third pleopod is ovate, and is without division; the endopod is much longer than broad. In the male the rami of the fourth pleopods are very thin, but both are well marked with branchial folds. The exopod of the fifth pleopods has a division and two lobes on the distal portion, and two at the inner distal angle of the proximal part opposite each other on each side. There are no small setæ on the external margin of this ramus.

In the uropods the peduncle and endopod are fused, and the exopod occupies a notch in the side. The end of the endopod slightly exceeds the end of the pleon.

The description and figures are taken chiefly from female specimens; the males I possess, which appear to be full grown, are much smaller.

This genus bears much external resemblance to *Chitinopsis*, Whitelegge.

Gulf St. Vincent, shallow water.

Moruloidea, n. gen.

Moruloidea lacertosa, n. sp.

Plate vii., figs. 1 to 10.

The body is expanded, moderately convex, the epimera of the thorax extending obliquely, and form, with their segments each side, a longitudinal shallow groove, which converges a little behind, continuing a similar groove extending round the pleon.

The head is short, with a small depressed rostral projection; much narrower than the first segment of the thorax; nodular and abruptly declivous in front.

The eyes are small.

The first segment of the thorax is broad and longer than any of the others which follow, rather nodular, its sides showing three faint tubercles on each margin; it is depressed anteriorly rather deeply; the extreme antero-lateral angles beneath the eyes are bifid or emarginate. Of the epimera of the following segments the fourth is longer fore and aft than the rest, the last is very short; they (six) are slightly accentuated at each posterior angle by a slight nodule or tubercle.

The anterior portion of the pleon, which is produced to a pointed plate laterally, is short, with the sutural lines scarcely showing. The posterior portion is dome-shaped and tuberculate, with its anterior angles also produced to points, the sides are slightly insinuate, thin, ending posteriorly in acute teeth, which do not reach the level of the sides of the posterior notch, the margins between which are insinuate. The notch is oblique in direction, rather deep, rectangular, its base slightly convex.

The basal antennular joints are not much expanded: they are uneven, rounded, and project very little beyond the head; the distal end of the first joint is not notched, or scarcely so; the second joint is short, small, and has a backward direction; the third joint is narrower and longer than the second; the flagellum short and slender, with 11 joints.

The antennæ are unusually large, all the joints of the peduncle are robust, the second has a distal obtuse tooth

on the inner side, the fifth joint is a little longer than the preceding one, slightly curved, and bent back at an angle with it. The flagellum, the first four joints of which are robust, is turned in the opposite direction; it bears 11 joints, the terminal ones being very small.

The epistome is short, broader than long, with the small anterior surface nearly at right angles to the posterior part; it is rough, and tapers quickly to an acute point beneath the rostral projection; the upper lip is slightly convex.

In the maxillipeds the lobes of the palp are rather long, resembling those in the *Cymodocinæ*.

The first gnathopods are very robust in contrast to the rest of the legs, a short thick basis is subequal in length to the ischium; the three following joints are sparely provided with spines (3 each), which are not serrate, but are apically split. The dactylus is strong, not forming with the propodus a subchelate or prehensile organ, but being somewhat inclined that way.

The first pleopods are smaller than the rest; the exopod is nearly oblong, and, lying obliquely, projects at its base beyond the edge of the peduncle; the endopod is slightly longer than broad. The second pleopods have the endopod a good deal longer than broad, with a thick *appendix masculina*, which reaches as far as its fringe; the exopod is ovate and smaller than the endopod. In the third pleopods the exopod is longer than the endopod, with an oblique suture ending in a small notch on the inner margin. The exopod of the fifth pleopod has the division very near the end; terminally there are two lobes nearly on the same level, and two small or rudimentary at the inner end, one above the other, below the suture.

The uropods are placed on the edge of the pleon, they are sublaminar; the peduncle has an anterior projection slightly over-reaching that of the antero-lateral angle of the pleon; the inner ramus is broad, curved, and distally bifid, its end scarcely reaching the posterior tooth of the pleon; the outer ramus is shorter and narrower, and has its upper surface slightly carinate, with its outer side nearly straight, the inner convex, the end acute.

One male specimen.

This genus seems to differ considerably from any others of the group that I am acquainted with. The much-developed antennæ and the large first pair of gnathopods are, as far as I know, unique.

Gulf St. Vincent.

Genus *Dynamenopsis*, new gen.

Dynamenopsis obtusa, n. sp.

Plate vii., figs. 11 to 17; and plate viii., figs. 1 to 7

The body is smooth, except on the pleon, which is rather rough, glabrous, very convex, becoming slightly wider at the end of the thorax.

The head is anteriorly rounded, without a transverse anterior ridge, longer than the first segment of the thorax. The eyes are rather small.

Of the segments of the thorax the first and seventh are longer than the rest, and subequal in length. The seventh almost completely covers the anterior portion of the pleon; its posterior border has four short lobes, the two median ones projecting somewhat behind. The epimeral plates of the thoracic segments are vertical in direction; that of the first segment is well produced anteriorly, but posteriorly very little; the following four are subquadrate; that of the sixth is wedge-shaped and produced behind, more than overlapping that of the seventh segment and the lateral portion of the anterior part of the pleon.

The posterior portion of the pleon is dome-shaped, and has a conical tubercle each side of the median line, with a smaller one posteriorly just above the posterior notch. The posterior notch is a transversely-ovate foramen, a closed slit below forming a funnel-shaped tube, the two sides form a small notch at the immediate end, while the sides of the pleon are turned under, enclosing the pleopods much more than is usual.

The first joint of the antennulary peduncle is not very broad; it is about twice as long as the second, and is without distal notch or produced angle. The second joint has a slight keel; the third joint is as long as the second, expanding a little distally. The flagellum is as long as the last two joints of the peduncle together, and has 8 short joints. The antennal peduncle is only a little longer than that of the antennule; its flagellum has 11 joints.

The anterior part of the epistome is not separated from the depressed rostral projection; this fits into a notch of the epistome with a sutural line marking the union, the whole being in the same curved surface with the front of the head. The labrum is quadrate.

The mandibles are abnormal, without distinct incisory plates, secondary plate, and spine rows, neither is there a distinct molar, but the part corresponding to the posterior edge of the molar bears a few brown recurved spines.

The maxillipeds are rather slender.

The first pair of gnathopods are robust, the ischium has an anterior lobe, the merus is short and wide, with a small distal spine behind, as also has the wedge-shaped carpus and the propodus; the dactylus is robust. The remaining legs are robust, with a few spines, but with the furry pads on the usual joints. The dactyli are well developed in all.

The endopod of the first pleopod is considerably longer than broad, thickened on its inner margin, with the outer margin slightly insinuate, but with a proximal angle or projection. The exopod is much larger, although reaching the same distance as the endopod; it lies obliquely, and the fringes of both are long. The outer end of the peduncle of this limb narrows out somewhat. In the second pair the exopod is much shorter and smaller than the endopod; the appendix exceeds the length of the endopod, including its fringe; there is a short ridge on the inner side of the endopod. The third pleopod has the peduncle much longer at its inner side; the exopod is divided near its end.

The uropods are lamellar, subequal in size, rounded on their distal margins, the outer one being slightly concave above.

The two processes of the seventh sternite of the thorax are short.

This species, represented by only one male, is from Denial Bay, and was collected by Drs. Verco and Torr in January, 1908.

Genus *Circeis*, M. Edw.

Circeis tridentata, M. Edw.

Plate viii., figs. 8 to 16.

This species is the type of the genus, and is here noted for purposes of comparison.

The body is shaped typically, being somewhat vertically compressed, with the head gradually declivous and narrowing considerably, and is very like *C. acuticaudata*, Haswell; in fact, the females are hard to distinguish from those of that species.

The posterior notch of the pleon in the male is deep, narrow, widening inwardly, the median process slightly raised, broadly triangular, obscuring the base in a dorsal view, not projecting as far as the arms of the notch, which are terminally obtuse.

The distal end of the first joint of the antennule has the posterior limb of the notch curved, and projecting much more than the anterior limb, but not quite reaching the end of the second joint.

The exopod of the first pleopod has 11 strong teeth.

The exopod of the second pleopod has 21 teeth.

The exopod of the third pleopod with a division and 10 teeth.

The exopod of fifth pleopod with two lobes on the distal portion, and two on the inner margin, near the middle of the lamina.

The legs in both sexes are provided with the furry pads so common in this group.

The female is more convex than the male, with a more ovate outline. The posterior portion of the pleon is more dome-shaped, the small median tubercle less marked, and this portion is less hairy. The posterior notch is simple, narrow, rather deep, cut nearly vertically, U-shaped. The uropods are similar in shape to those of the male, but smaller. The legs are less robust, and the teeth on the pleopods smaller.

The eggs I have found deep in the body, quite to the dorsal surface, and the usual modifications of the mouth parts and viscera occur.

Circeis trilobata, n. sp.

Plate viii., figs. 17 to 20; and plate ix., figs. 1 to 7.

The body of the male narrows anteriorly, as seen in other species of this genus; it is smooth—except on the posterior portion of the pleon, where there are a few small granules—and glabrous.

The head is longer than the first thoracic segment and narrower, with a very small depressed rostral projection.

The eyes are large, and slightly projecting.

The first segment of the thorax and the seventh are subequal in length, and are longer than the remaining segments. The epimeral plates are marked off from their respective segments by faint longitudinal grooves; the antero-lateral angle of the first segment projects forward very much, but not much posteriorly; the succeeding plates project behind each in a slightly increasing degree, except the last, which also is not so deep.

The anterior portion of the pleon is subequal in length to the seventh thoracic segment, and it is slightly raised in the middle. The posterior portion bears three bosses, the median one of which is somewhat triangular and abrupt behind, the lateral ones less so; behind these is a semicircular depression, but the immediate region of the posterior notch is tumid. The notch is simple, cut nearly vertical, quadrate, with a convex base, but no real process.

The epistome is long, anteriorly appearing thickened, but actually slightly turned upward at the tip, occupying

most of the interantennulary space. When viewed in profile the two posterior limbs each show two small projections, one above the other, on the inner borders.

The basal antennular joint is rather short, its posterior distal angle produced, reaching nearly to the end of the second joint; the anterior angle is scarcely produced. The second joint is distally truncated, and does not show a slight notch or insinuation above, as in *C. tridentata* and *C. acuticaudata*. The under keel is well marked. The third joint is much narrower and about as long as the second; the flagellum has 10-11 joints.

The antenna has a flagellum of 13 joints, and is slightly longer than its peduncle.

The legs are of the usual type, rather robust, sparingly spined, their places being occupied by furry pads, even in the first pair of gnathopods. The dactyli are short.

The mandibles have incisory plates, moderately strong and dentate; the left mandible has a secondary plate, tridentate. The spine row and molar of each are well developed.

The filaments of the male on the seventh thoracic sternite are short.

The endopod of the first pleopods is nearly twice as broad as long: the exopod has a row of well-marked teeth on the external border. The exopod of the second pleopod has a row of teeth and a row of small simple setæ close to the external border; the fringes of the usual setæ are very dense. The *appendix masculina* is short, and proceeds from about the middle of the inner border of the endopod. The exopod of the third pleopod has a suture rather near the end, and 5 or 6 distal teeth, also a row of small simple setæ near the external border. The exopod of fifth pleopod has a distal suture very obscure; the two lobes which this carries are rather distant from each other. A third small lobe is on the proximal division, rather far down on the inner side.

The uropods are lamellar.

The female resembles the male when not young-bearing. The young-bearing female is broader or more ovate and shorter, and the legs are much slenderer; the posterior notch is similar in shape, but rather deeper; the greatest difference is found in the uropods, the shape of which is seen by reference to the figure. The marsupial plates are large and overlapping, and the young and eggs are found deep in the body. The mouth parts are strongly modified. The young males and females bear great resemblance to the females of *Haswellia emarginata*.

Gulf St. Vincent, from jetty piles.

Circeis obtusa, n. sp.

Plate ix., figs. 8 to 17.

The body is rather broad, convex, the surface is rather rough, with granules becoming well developed on the pleon, glabrous.

The head is not so pointed as in other species of this genus; rather short, anteriorly strongly declivous, with an anterior faint transverse ridge.

The eyes are well developed.

The epimeral plates of the thoracic segments are not distinctly marked off from the segments. They are vertical in direction.

The anterior portion of the pleon is short. The posterior portion dome-shaped, with a very slight depression each side of a median faint elevation. The posterior notch is well marked, narrower at its apex than at its base, with a V-shaped median lobe, which reaches about halfway to the end. In a side view the end appears slightly turned up.

The epistome has its anterior portion slightly convex.

The basal joint of the antennular peduncle has a distal notch whose posterior limb does not reach the end of the second joint; the anterior limb is nearly as long as the posterior, and is slightly turned forward at its apex. The third joint is narrow and slightly longer than the second; the flagellum has 11-12 short joints of a moniliform appearance.

The flagellum of the antenna has 13 longer joints.

The mandibles are large, the primary plates are well developed and dentate; the secondary plate also is well developed, as also are spine rows and molars.

The maxillipeds have the plate of the second joint as long as the joint itself; the palp is well developed.

The legs are strong. The first gnathopods have well-developed spines on fourth, fifth, and sixth joints. In the other legs the spines are replaced mostly by the furry pads.

The first pleopods have short endopods, much broader than long. The exopod is without marginal teeth, or with only one or two faint ones. Internally, from the usual row of marginal setæ, there is a row of setules, as noticed in other species. Second pleopods, with the endopods also short, bearing the *appendix*, nearly halfway along its internal border. The appendix is thick, and nearly of the same diameter its whole length. The exopod has 4-5 small teeth on its external border and a row of setules. The exopod of the third pleopods has a division and a row of setules, as in the others. The exopod of the fifth pleopods has three lobes, which are slender, the most distal one projecting horizontally, the most proximal close to the inner margin. The division is very obscure.

The uropods are lamellar, rather broad, the inner ramus distally truncate and exceeding the end of the pleon. The outer ramus rather ovate, slightly exceeding the inner, the margins of both faintly and irregularly serrate.

This species is represented by two males, the females being unknown.

Gulf St. Vincent.

Haswellia emarginata, Haswell.

Plate ix., fig. 18; and plate x., figs. 1 to 11.

The body becomes narrower anteriorly, smooth, with very few hairs towards the lateral margins.

The head is slightly longer than the first segment of the thorax, with a well-marked rostral projection very acute at the tip.

The eyes are large, and project slightly.

The segments of the thorax behind the first increase in length successively behind, while the seventh tapers to a long process, which extends beyond the end of the pleon, and is terminally truncated and notched or emarginate.

The epimeral plates of the thoracic segments are produced subacutely behind, except that of the seventh, which is large and rounded; sutures marking off these plates are not evident.

The anterior portion of the pleon is covered, except at the sides. The posterior portion is depressed and slightly granular. The posterior notch is very deeply cut, its median process projecting well beyond the sides, is truncated, and slightly notched.

The first joint of the antennular peduncle is rather broad; there is a deep distal notch, the arms of which are equal in length, and do not reach the end of the second joint; the anterior one is curved outwards a little at the end. The second joint has a prominent keel below, ending distally in an acute tooth. The flagellum has 17 small joints.

The antennal flagellum has 17 joints.

The mandibles are rather slender, the incisory plates are entire, the other parts are well developed.

The legs are similar to those found in the genus *Circeis*.

The exopods of the first and second pleopods are toothed, as also in the genus mentioned. The *appendix masculina* is small, and originates rather far along the inner margin of the endopod of the second pleopods. In the third pleopods the transverse suture is near the end; the setules noticed before are present.

The uropods are broad and very rigid. The exopod has the inner margin more convex than the outer; this is minutely serrate. The inner ramus is large and slightly

sigmoid, its inner margin has a slight prominence near the distal acute end; both are densely fringed with short setæ, as well as having hairy surfaces, and project slightly beyond the median process of the seventh thoracic segment.

In an egg-bearing female the first and second pleopods are areolate in both rami; the exopods in both instances have teeth, but they are less numerous and weaker than in the males. The setules near the margin are present.

The marsupial plates are large and overlapping, the eggs are internal in densely packed masses up to the dorsal region, and even amongst the muscles which control the pleopods. The mouth parts are very much modified.

The end of the pleon has a deep vertical notch with its roof slightly projecting behind; this is rather obtusely pointed and conspicuous from the side.

Females without brood and young males approach each other, though at an early stage the young male has a short developing process to the seventh thoracic segment. In both these cases the posterior notch, though not so deep, is more roofed over by the triangular process than in the female with brood, and the process is more acute.

I have repeated the observation with regard to the eggs with *Circeis acuticaudata*, Haswell, and have found the young deep in the body apparently as well developed as those immediately under the marsupial plates; few were in that position, the majority—very numerous—were within the body, even over the pleopods.

As Dr. Hansen remarks, *Haswellia* is closely allied to *Circeis*, there being, as far as I am aware, only the character of a dorsal process separating them.

Gulf St. Vincent; a common species.

Haswellia cilicioides, n. sp.

Plate x., figs. 12 to 23.

The body is very convex, gradually narrowing towards the anterior end; smooth, except on the pleon and uropods, which are granulate and glabrous, except the margins of the uropods, which are slightly hairy.

The head is obliquely declivous and rounded in front. The eyes are scarcely raised above the surface.

The first and sixth thoracic segments are subequal in length, the seventh produced as a process which is rather broad, curved downwards, and distally obtusely rounded, over-reaching the end of the pleon and excavated a little underneath. The epimeral plates of the thorax are vertical in direction, not forming with their respective segments a perceptible longitudinal groove.

The anterior portion of the pleon, with its two transverse sutures, are well seen at the sides. The posterior portion has three lobes, the middle one slightly projecting behind more than the others; below these the surface is slightly excavated medianly, and then descends obliquely to the posterior notch. The posterior notch is shallow, the channel becoming deeper inwardly; there is a median triangular process which over-reaches the sides, is oblique in direction, and subacute.

The first peduncular joint of the antennule has the usual distal notch, the posterior limb of which is longer than the anterior, but does not reach the end of the second joint. The third joint is longer and narrower than the second. The flagellum has 14 joints.

The antenna has the last peduncular joint longer than the one which immediately precedes it; its flagellum has 16 joints.

The epistome shows very slight projections in the corresponding positions as in *Circeis trilobata*.

Mandibles well developed, with the usual features well marked.

The first gnathopods are shorter and stouter than any of the legs which follow, though not markedly so; the basis is thickened, the ischium subequal in length to the three succeeding joints taken together, these are posteriorly spined; the dactylus is moderately developed.

The following pairs of legs are moderately long, and differ only in the relative length of the joints; they are poorly or scarcely at all spined. The furry pads are present on the usual joints.

In the first pleopods the endopod is much broader than long. The exopod has 6-7 marginal teeth; both rami are areolate. The exopod of the second pleopod has areolate markings, and the row of setules near the outer margin; on the same margin there are 12 teeth. The *appendix masculina* is short and thick, and is attached to about the middle of the inner margin of the endopod. The endopod is broader than long, and has a few areolate markings. The third pleopods are larger than the two pairs which precede them without marginal teeth on the exopod, but with the row of setules as in the others. The division is near the end, and there are indistinct areolæ. The endopod is distally truncate. The exopod of the fifth pleopod has three lobes, the two distal ones well developed and well apart, the third on the inner margin also well marked.

The uropods have the inner ramus much reduced, the outer one strongly developed, subcylindrical, curved inwards,

fringed with fine hair, and over-reaching the median process of the seventh thoracic segment.

The female of this species has not been recognized.

Gulf St. Vincent.

DESCRIPTION OF PLATES.

All figures are from adult males, except where otherwise mentioned.

The legs are drawn to approximate proportion in each individual.

Plate III.

Fig. 1. *Cymodoce longicaudata*, n. sp., magnified 2½ diameters.
,, 2. ,, ,, side view of male.
,, 3. ,, ,, pleon from below.
,, 4. ,, ,, antennula, antenna, and epistome.
,, 5. ,, ,, left mandible.
,, 6. ,, ,, maxilliped.
,, 7. ,, ,, first gnathopod.
,, 8. ,, ,, second gnathopod.
,, 9. ,, ,, fourth pereiopod.
,, 10. ,, ,, second pleopod.
,, 11. ,, ,, exopod of fifth pleopod.
,, 12. ,, *tuberculosa*, Stebbing, magnified 4 diameters.
,, 13. ,, ,, pleon from below.
,, 14. ,, ,, antennula, antenna, and epistome.
,, 15. ,, ,, second pleopod.

Plate IV.

,, 1. *Cymodoce hamata*, n. sp., magnified 4 diameters.
,, 2. ,, ,, female, magnified 4 diameters.
,, 3. ,, ,, side view of male.
,, 4. ,, ,, pleon from below.
,, 5. ,, ,, female pleon from below.
,, 6. ,, ,, antennula, antenna, and epistome.
,, 7. ,, ,, maxilliped.
,, 8. ,, ,, first gnathopod.
,, 9. ,, ,, second gnathopod.
,, 10. ,, ,, fifth pereipod.
,, 11. ,, ,, second pleopod.
,, 12. *Cilicæa curtispina*, Haswell, magnified 2½ diameters.
,, 13. ,, ,, side view of male.
,, 14. ,, ,, female, magnified 2½ diameters.
,, 15. ,, ,, pleon from below.
,, 16. ,, ,, female pleon from below.
,, 17. ,, ,, antennula, antenna, and epistome.

Plate V.

,, 1. *Cilicæa curtispina*, Haswell, left mandible, with palp.
,, 2. ,, ,, maxilliped.
,, 3. ,, ,, first gnathopod.
,, 4. ,, ,, second gnathopod.
,, 5. ,, ,, fifth pereiopod.
,, 6. ,, ,, endopod of first pleopod, anterior and posterior aspect.
,, 7. ,, ,, exopod of fourth pleopod.
,, 8. ,, ,, exopod of fifth pleopod.
,, 9. *Dynamene ramuscula*, n. sp., magnified 6 diameters.
,, 10. ,, ,, side view of male.

Fig. 11. *Dynamene ramuscula*, female, magnified 6 diameters.
,, 12. ,, ,, pleon from below.
,, 13. ,, ,, female pleon from below.
,, 14. ,, ,, antennula, antenna, and epistome.
,, 15. ,, ,, maxilliped.
,, 16. ,, ,, first gnathopod.
,, 17. ,, ,, second gnathopod.
,, 18. ,, ,, fifth pereiopod.
,, 19. ,, ,, second pleopod.
,, 20. ,, ,, third pleopod.

PLATE VI.

,, 1. *Amphoroidea angustata*, n. sp., male magnified 4 diameters.
,, 2. ,, ,, pleon from below.
,, 3. ,, ,, antennula, antenna, and epistome.
,, 4. ,, ,, maxilliped.
,, 5. ,, ,, first gnathopod right.
,, 6. ,, ,, second gnathopod right.
,, 7. ,, ,, third pereiopod right.
,, 8. ,, ,, first pleopod.
,, 9. ,, ,, second pleopod.
,, 10. ,, ,, exopod of fifth pleopod.
,, 11. *Amphoroidella elliptica*, n. sub-gen., n. sp., magnified 2½ diameters.
,, 12. ,, ,, oral region from below.
,, 13. ,, ,, pleon from below.
,, 14. ,, ,, right mandible.
,, 15. ,, ,, second gnathopod.
,, 16. ,, ,, fifth pereiopod.
,, 17. ,, ,, first pleopod.
,, 18. ,, ,, second pleopod.

PLATE VII.

,, 1. *Moruloidea lacertosa*, n. gen., n. sp., magnified 3½ diameters.
,, 2. ,, ,, side view.
,, 3. ,, ,, antennula, antenna, and epistome.
,, 4. ,, ,, maxilliped.
,, 5. ,, ,, first gnathopod.
,, 6. ,, ,, second gnathopod.
,, 7. ,, ,, fifth pereiopod.
,, 8. ,, ,, first pleopod.
,, 9. ,, ,, second pleopod.
,, 10. ,, ,, exopod of fifth pleopod.
,, 11. *Dynamenopsis obtusa*, n. gen., n. sp., magnified 5 diameters.
,, 12. ,, ,, side view.
,, 13. ,, ,, antennula, antenna, and epistome.
,, 14. ,, ,, pleon from below.
,, 15. ,, ,, left mandible.
,, 16. ,, ,, right mandible.
,, 17. ,, ,, maxilliped.

PLATE VIII.

,, 1. *Dynamenopsis obtusa*, n. gen., n. sp., first gnathopod inside view left.
,, 2. ,, ,, second gnathopod left.
,, 3. ,, ,, fifth pereiopod left.
,, 4. ,, ,, first pleopod.
,, 5. ,, ,, second pleopod.
,, 6. ,, ,, third pleopod.
,, 7. ,, ,, exopod of fifth pleopod.

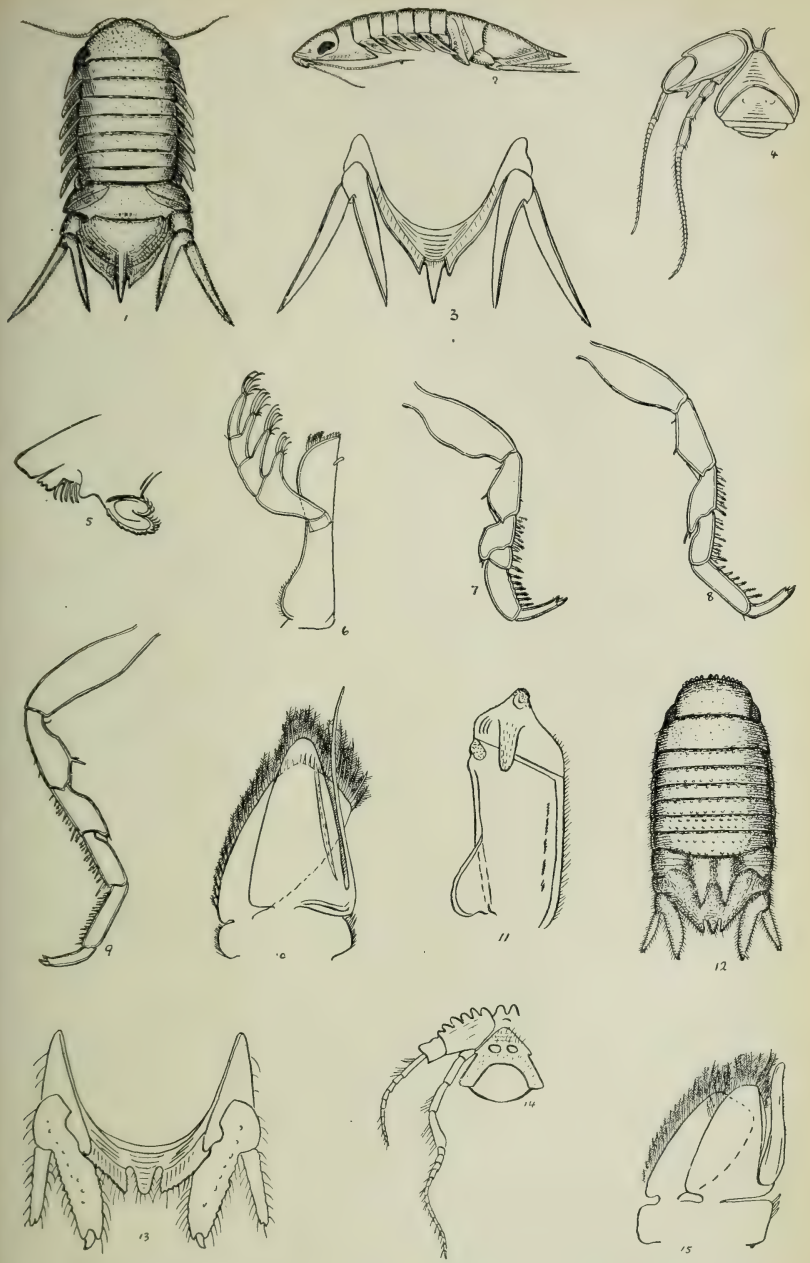
Fig. 8. *Circeis tridentata*, M. Edw. magnified 2½ diameters.
,, 9. ,, ,, female, magnified 2½ diameters.
,, 10. ,, ,, side view of male.
,, 11. ,, ,, antennula and epistome.
,, 12. ,, ,, maxilliped.
,, 13. ,, ,, pleon from below, male.
,, 14. ,, ,, first gnathopod.
,, 15. ,, ,, fourth pereiopod.
,, 16. ,, ,, second pleopod.
,, 17. ,, *trilobata*, n. sp., magnified 4 diameters.
,, 18. ,, ,, side view of male.
,, 19. ,, ,, pleon from below, male.
,, 20. ,, ,, female pleon (egg-bearing) from below.

PLATE IX.

,, 1. *Circeis trilobata*, n. sp., antennula, antenna, and epistome.
,, 2. ,, ,, maxilliped.
,, 3. ,, ,, first gnathopod.
,, 4. ,, ,, second gnathopod.
,, 5. ,, ,, fifth pereiopod.
,, 6. ,, ,, second pleopod.
,, 7. ,, ,, exopod of fifth pleopod.
,, 8. ,, *obtusa*, n. sp., magnified 3½ diameters.
,, 9. ,, ,, side view.
,, 10. ,, ,, pleon from below.
,, 11. ,, ,, antennula, antenna, and epistome.
,, 12. ,, ,, maxilliped.
,, 13. ,, ,, first gnathopod right.
,, 14. ,, ,, second gnathopod right.
,, 15. ,, ,, fourth pereiopod right.
,, 16. ,, ,, second pleopod.
,, 17. ,, ,, exopod of fifth pleopod.
,, 18. *Haswellia emarginata*, Haswell, magnified 3 diameters.

PLATE X.

,, 1. *Haswellia emarginata*, Haswell, pleon from below.
,, 2. ,, ,, young female, magnified 3 diameters.
,, 3. ,, ,, female pleon from below.
,, 4. ,, ,, pleon of young male from above.
,, 5. ,, ,, pleon of egg-bearing female.
,, 6. ,, ,, antennula, antenna, and epistome.
,, 7. ,, ,, mandible of young female.
,, 8. ,, ,, exopod of second pleopod young female.
,, 9. ,, ,, exopod of second pleopod egg-bearing female.
,, 10. ,, ,, second pleopod.
,, 11. ,, ,, exopod of fifth pleopod.
,, 12. ,, *cilicioides*, n. sp., magnified 3½ diameters.
,, 13. ,, ,, side view.
,, 14. ,, ,, pleon from below.
,, 15. ,, ,, epistome.
,, 16. ,, ,, antennula.
,, 17. ,, ,, left mandible.
,, 18. ,, ,, maxilliped.
,, 19. ,, ,, first gnathopod.
,, 20. ,, ,, second gnathopod.
,, 21. ,, ,, fifth pereiopod.
,, 22. ,, ,, second pleopod.
,, 23. ,, ,, exopod of fifth pleopod.



CYMODOCE LONGICAUDATA, *n. sp.* CYMODOCE TUBERCULOSA, *Stebbing.*

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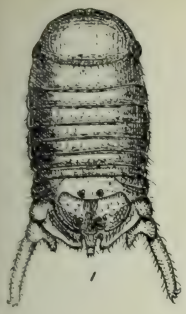
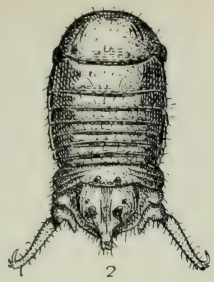
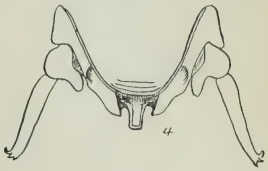
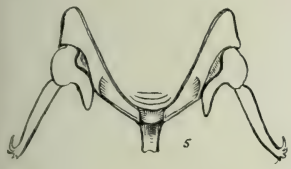
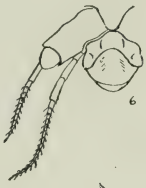
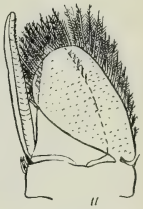


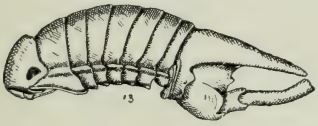


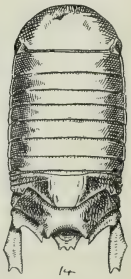


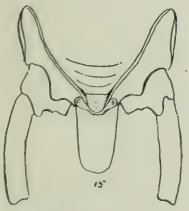


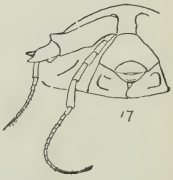






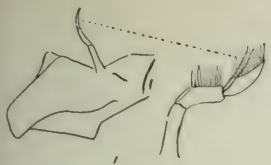
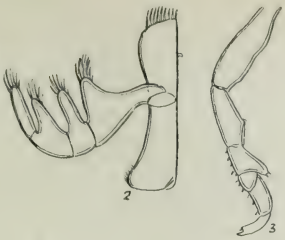


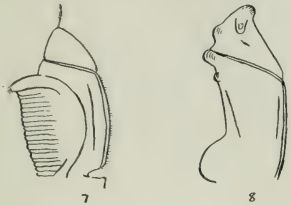
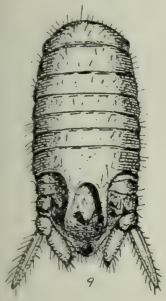


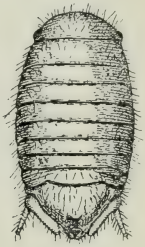
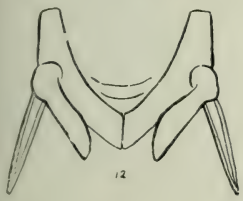
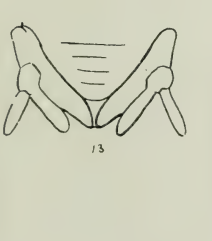
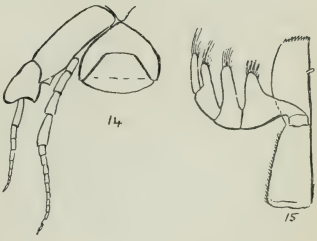


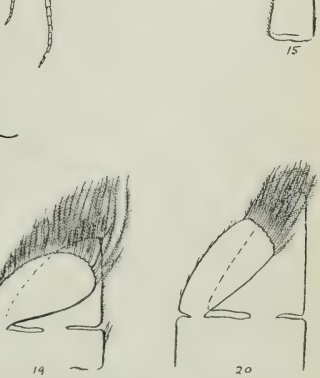
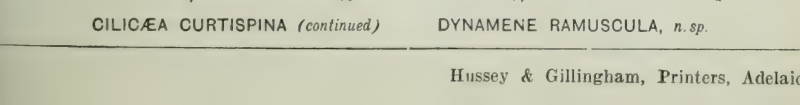
CYMODOCE HAMATA, *n. sp.* CILICÆA CURTISPINA, *Haswell.*

Hussey & Gillingham, Printers, Adelaide.

CILICÆA CURTISPINA *(continued)* DYNAMENE RAMUSCULA, *n. sp.*

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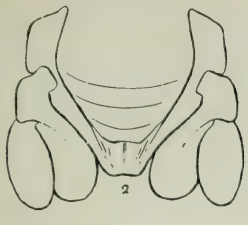
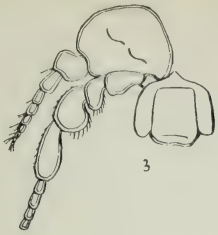
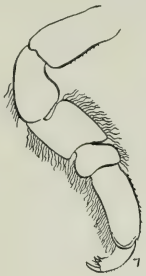
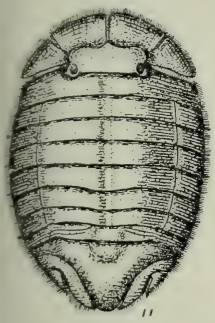
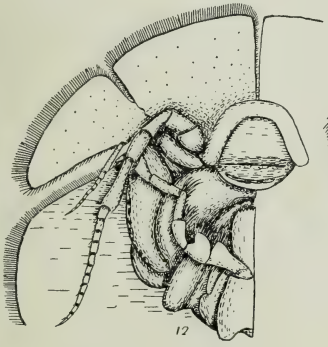
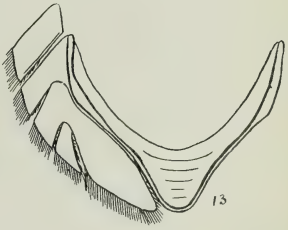


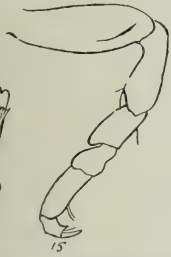


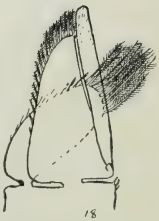






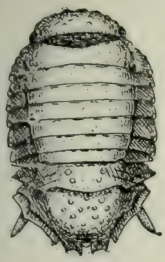


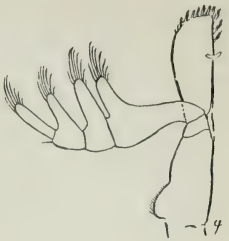


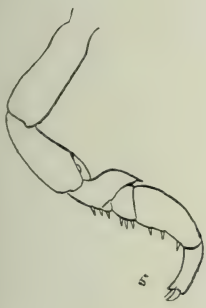


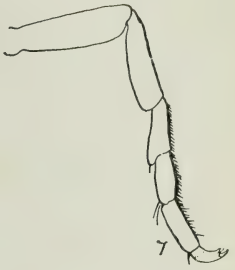
AMPHOROIDEA ANGUSTATA. *n. sp.* AMPHOROIDELLA ELLIPTICA, *n. sub. gen.. n. sp*

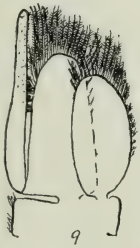
Hussey & Gillingham, Printers, Adelaide.

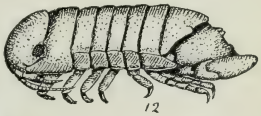


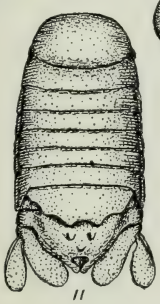


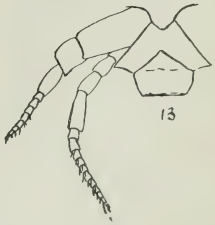


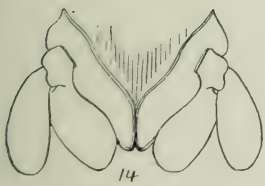












MORULOIDEA LACERTOSA, *n gen., n. sp.*

DYNAMENOPSIS OBTUSA, *n gen., n sp.*

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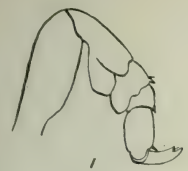

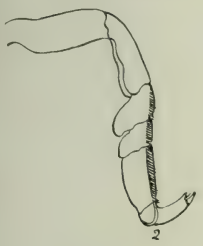

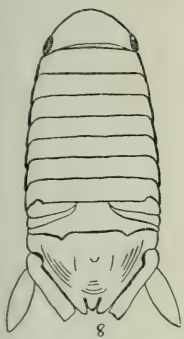

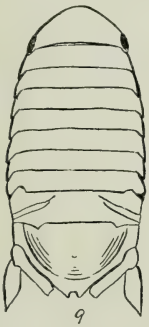

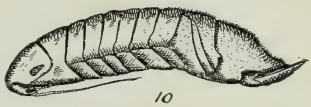

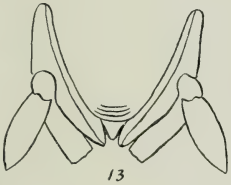

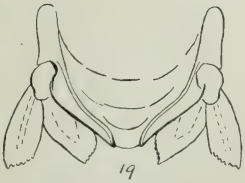

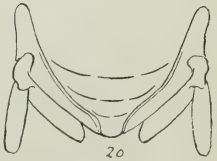

DYNAMENOPSIS OBTUSA *(continued)*. CIRCEIS TRIDENTATA. CIRCEIS TRILOBATA, *n. sp.*

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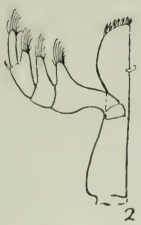

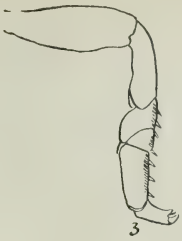

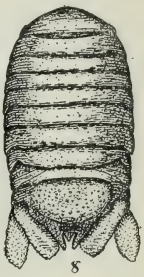

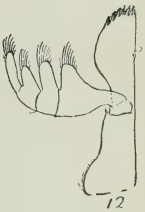

CIRCEIS TRILOBATA *(continued)* CIRCEIS OBTUSA, *n sp.* HASWELLIA EMARGINATA, *Haswell.*

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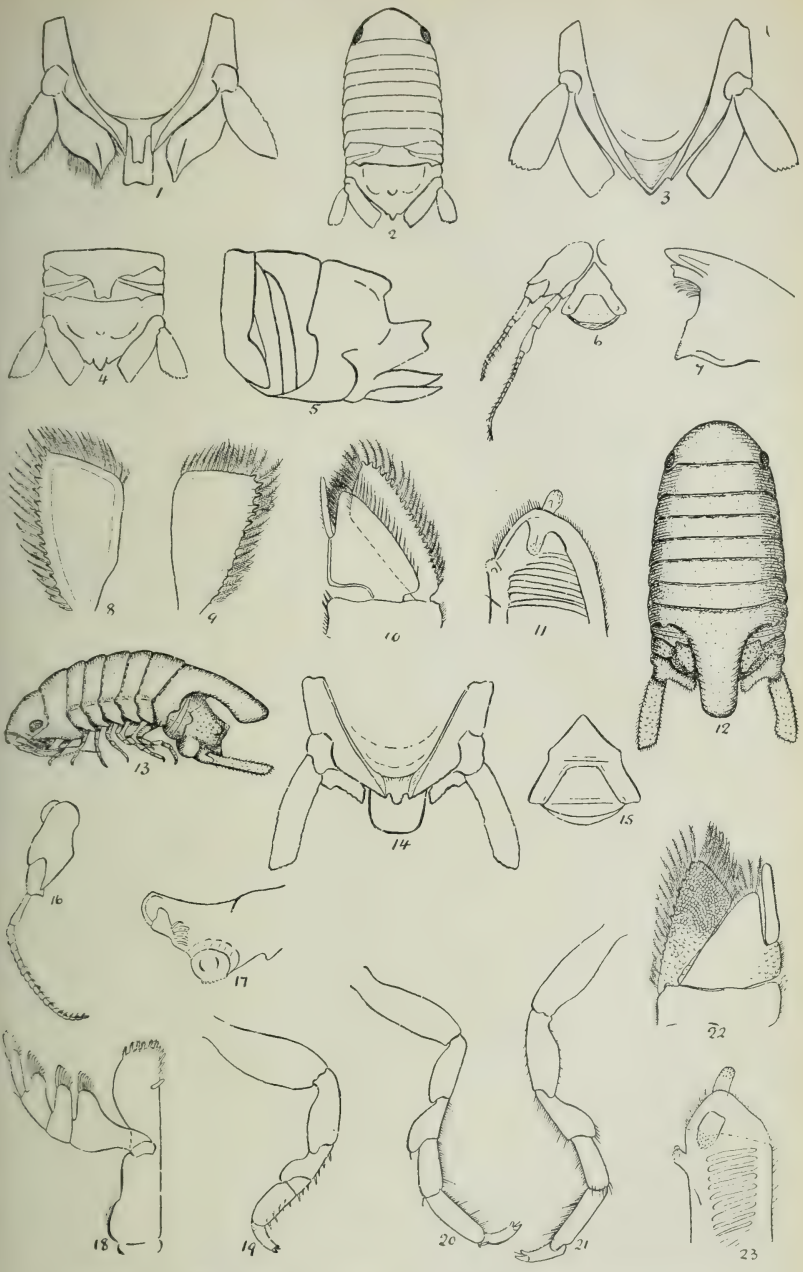

HASWELLIA EMARGINATA *(continued.)* HASWELLIA CILICIOIDES, *n. sp.*

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Secondary γ Radiation.

By J. P. V. Madsen, D.Sc. (Adel.), B.E. (Syd.), Lecturer in Electrical Engineering, University of Adelaide.

[Read July 17, 1908.]

Introduction.

As a result of the passage of γ rays through matter, secondary rays of two types make their appearance. As it will be necessary to distinguish between the secondary rays which proceed from the sides at which the original γ rays enter and emerge from the plate which they penetrate, we shall refer to these as the "incidence" and "emergence" rays respectively.

The secondary radiation consists of β and of γ rays.

The former appear on both sides of the plate; the "incidence" β rays have been recently investigated in some detail by Kleeman (Phil. Mag., Nov., 1907) and by Eve (Phil. Mag., June, 1908).

In papers by Professor Bragg and myself (Phil. Mag., May, 1908; Trans. Roy. Soc., S. Aus., v. xxxii., 1908) it is shown that most of the experimental results so far obtained with these rays can be very simply explained on the "material" theory, if we suppose that the β radiation is produced directly from the γ particle and at the outset moves in the direction of the original γ radiation, subsequently undergoing scattering in the ordinary manner of β rays.

The second type of secondary radiation resulting from the primary γ rays, viz., the secondary γ rays, have been investigated on the incidence side of plates of different material by Kleeman (Phil. Mag., May, 1908), and later by Eve (Phil. Mag., Aug., 1908).

It was a deduction made by Professor Bragg (Trans. Roy. Soc., S. Aus., Jan., 1908) from the theory of the material nature of X- and of γ rays previously propounded by him, that "the existence of modified or softened γ rays might be suspected, since there is an analogous effect in the case of X-rays; and probably they would be found more at the back of the penetrated plate than in front of it." The back and front sides spoken of here refer of course to the sides of emergence and incidence respectively.

It will be shown in the present paper that this prediction is fulfilled very exactly: that the want of symmetry in the amount of radiation from the two sides of the plate is very marked, that a softening of the original rays is effected,

and that in addition there is in some cases a lack of symmetry in the quality of the emergence and incidence γ radiation.

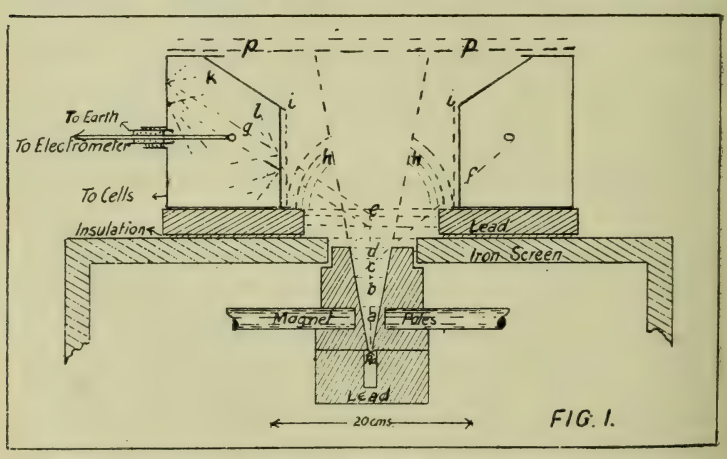
Kleeman, from a study of the incidence radiation, has advanced a theory of selective absorption, not only for the secondary but also for the primary γ rays. In the light of the more comprehensive information which can be obtained from a study of both the emergence and the incidence radiation, an attempt will be made in the present paper to show that most of the secondary ray effects can be explained, if we suppose that from the radium there are originally emitted two sets of homogeneous γ rays, which each subsequently suffer modification by the process of scattering, becoming softened and in some cases broken up, giving rise to β rays.

The present paper is intended to give a preliminary outline of the experimental work and general theory.

The measurements are in many cases small and difficult to make with any very great accuracy, but the effects to be described seem well marked. It will be necessary to extend with greater care many of the details of the work before it can be considered as at all complete.

§ I.

The arrangement of apparatus employed in the first experiments is shown in fig. i. The radium is placed near the



The γ radiation proceeds from the Ra through the conical hole. Radiators may be placed in its path as at e. The quality of the secondary radiation may be tested by the domes h,h or the cylinders i,i. When measuring the effects of the secondary incidence radiation, the ionization chamber is inverted and radiators placed as at p,p.

apex of a conical hole made in a block of lead. By means of a powerful magnet, the poles of which are shown, most of the β rays could be prevented from passing out of the conical hole. The magnet and lead block containing the Ra were surrounded by an iron case, to prevent the magnetic field from producing any effect in the ionization chamber. Resting upon the iron case and suitably insulated from it is placed a lead plate one inch thick, with a circular portion removed from the centre. The ionization chamber standing upon this lead plate is made of lead 1·25 mm. thick, and contains an insulated electrode in the form of a circular wire ring, suitably protected by sulphur, and connecting to the electrometer or to earth by suitable keys.

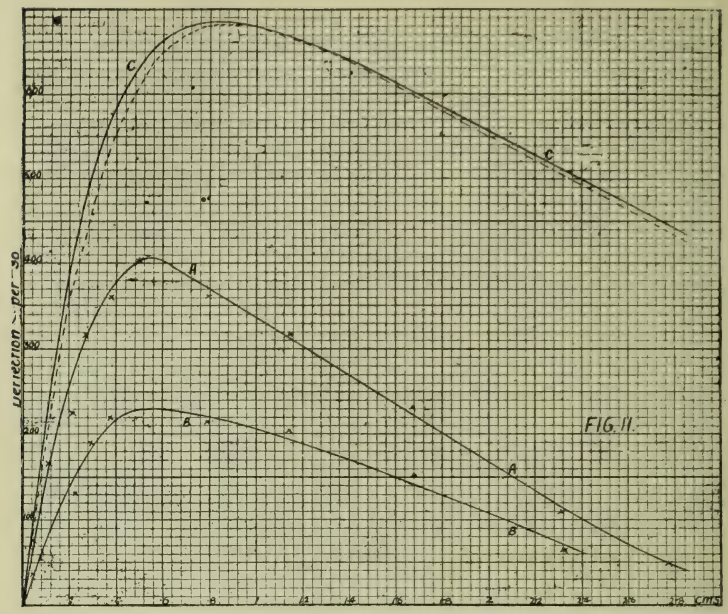
In the path of the γ radiation which proceeds from the conical hole, plates of material which are used as radiators can be placed horizontally as at e. When increasing the thickness of radiator the top plate is always kept in the position e, and additional thicknesses are placed immediately below and in contact with it. When large thicknesses are required, plugs of the material may be inserted in the conical hole.

The ionization chamber was filled with ethyl-chloride; this increased the effect considerably and worked very satisfactorily.

It was necessary to balance the leak due to natural ionization in the chamber, and to γ radiation which was not completely absorbed by the lead block and plates. For this purpose a balance chamber of about the same size as the ionization chamber was placed against one of the sides of the iron case insulated from it.

This was connected up in the usual manner, and was found to give quite sufficient balance with the ionization produced by the γ radiation which came through the sides of the lead block containing the Ra. The electrometer was a sensitive instrument of the Dolezalek pattern, giving a scale reading of about 4,000 divisions per volt; each division could easily be subdivided to tenths. The charge was allowed to pass into the electrometer for 30 sec., and the mean of the first and second swings was taken as the deflection.

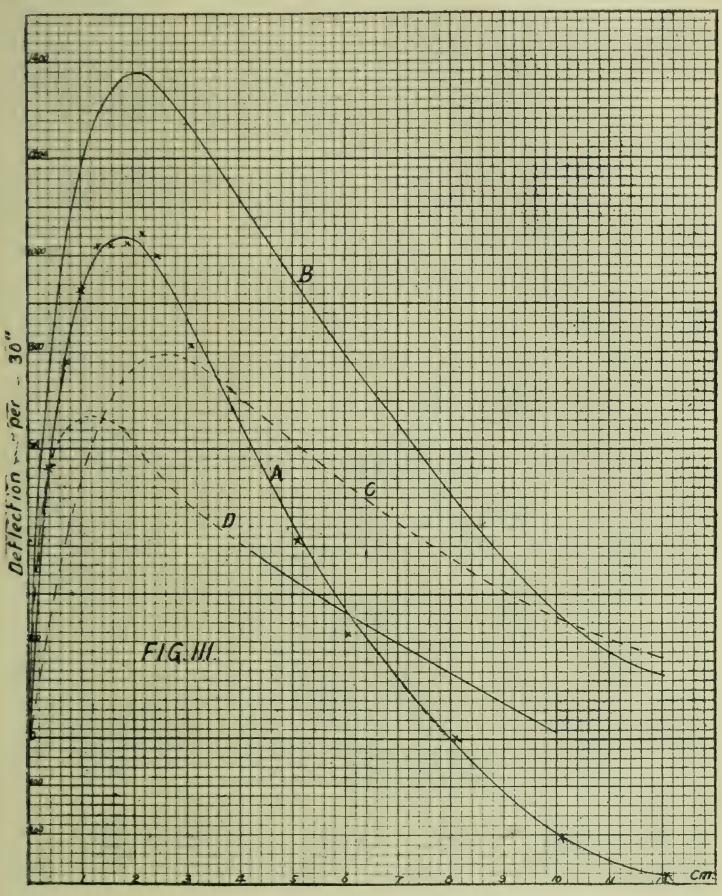
In fig. ii., curve A shows the effect of increasing the thickness of a Pb radiator. In an experiment, the zero leak was first obtained as a mean of several determinations, and this was subtracted from the measurement obtained with the radiator in position. It will be seen from the curve that the effect increases until a thickness of between 5 and 6 mm. of Pb is reached, after which it decreases gradually.



If, now, a hemispherical dome of Pb 4 mm. thick, with its central portion removed so as not to intercept the original stream of γ rays, be placed in the position shown by h,h, fig. i., and a set of observations be taken as before, subtracting the reading with the radiator in from that with it not in position, the curve B is obtained. Again, a maximum is reached for about the same thickness of radiation as before, but the effect is for the different thicknesses of radiator about 60 per cent. of its previous value. We may conclude that it is γ radiation which is being intercepted by the dome, as in neither case can any but a very small amount of β radiation pass obliquely through the thickness of 1·25 mm. of lead forming the sides of the ionization chamber; that from the radiator are proceeding secondary emergence γ rays which produce ionization in the testing chamber, as shown in previous papers by means of—

(a) "tertiary emergence" β rays as at l;
(b) tertiary incidence β rays as at k;
(c) β radiation produced in the gas of the chamber from the γ rays as they pass through it;
(d) possibly some ions produced directly in the gas by the γ rays; and
(e) subsequent β and γ ray effects of a higher order.

The results of a similar set of experiments without a Pb dome and with Zn as radiator are shown in fig. iii., curve *A*. The maximum value of the effect measured is considerably greater than in the case of Pb and occurs at a thickness of about 2 cm. of the radiator; for increased thick-



nesses the curve falls as in the case of Pb. It will be noticed that with sufficient thickness of radiator in this case the curve falls below zero. This was found to be due to the fact that a considerable amount of secondary γ radiation, proceeding from the sides of the conical hole in the Pb block containing the Ra, could enter the ionization chamber as

shown by the line *c,f* (fig. i.). As any radiator is increased in thickness it not only sends out its own secondary, but absorbs that coming from the sides of the conical hole. It will be shown later how proper correction can be made for this effect.

A third set of experiments was carried out with Al as radiator; the effects were of a similar nature as those from Zn, the maximum value being about the same in amount as for Zn, and was obtained with a thickness of about 4·5 cm.; but it was found that an appreciable difference was made when a plug of Al was placed at *b* in place of *d* as shown in fig. i., even though the total thickness of Al was kept the same in both cases. It will thus be seen that some secondary radiation can, after emerging obliquely from a depth of several cm. of Al, produce an effect in the ionization chamber. The present form of apparatus was therefore not suitable for obtaining from Al all the results so far obtained for Pb and Zn; in these latter it was found that similar errors were very small. It may, however, safely be said for Al as for Zn that the effect produced is considerably greater than for Pb.

We have so far neglected all consideration of the secondary radiation which comes from the sides of the conical hole; this it will now be shown is by no means small, but the correction which it introduced was found not to be sufficient to interfere with the deduction just made. Consequently we may say that Zn and Al both give out more secondary emergence γ radiation than does Pb, provided of course that the quality of the radiation in the two cases is not so different as to balance the effect.

In order to find the amount and nature of the radiation which proceeds from the sides of the conical hole, Pb domes were placed as at *h,h*, or Pb cylinders as at *i,i*, fig. i. When the latter were used, their equivalent thickness was found in terms of corresponding domes. A cylinder was found to be approximately equivalent to a dome 1·5 times its thickness.

The results of experiments upon the radiation from the sides of the cone are shown in fig. iv., curve *A*, in which thicknesses of dome are shown horizontally and the corresponding leaks per 30 sec. vertically.

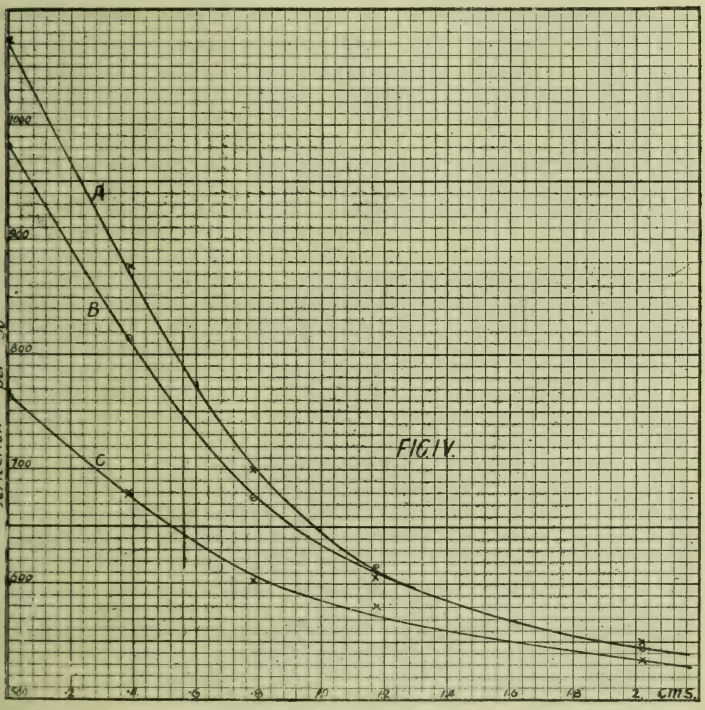
The curve *A* can be represented approximately by the expression $500 + 570e^{-1\cdot25d}$.

That the radiation comes from the sides of the cone can be shown by placing at *e*, fig. i., Pb plates in which circular holes are cut so as not to intercept the main stream of γ radiation coming from the Ra.

The results now obtained for different dome thicknesses are shown by curve B, fig. iv., which it will be seen can again be represented approximately by the expression $500 + 430e^{-1\cdot25d}$.

It seems reasonable to suppose that besides the constant normal leak in the ionization chamber, secondary γ radiation from the sides of the conical hole can enter the chamber, and that this radiation may for the purposes of correction to which it is to be applied later on, be taken as equivalent to a homogeneous radiation for which $\lambda = 1\cdot25$.

If now a Pb plug, 4 cm. deep, be placed in the conical hole in the position shown by a, fig. i., so as to intercept the main stream of γ radiation, but still leave the sides of the cone exposed to the ionization chamber, and a set of experiments similar to the above be performed, the results shown in curve C, fig. iv., are obtained. These again are approximately represented by $500 + 270e^{-1\cdot25d}$.



It is not surprising that the constant normal leak has not been reduced to any appreciable extent, for it will be

seen from fig. i. that the plug would hardly intercept any γ radiation passing directly from the Ra to the ionization chamber. On the other hand, we obtain a rather important result, for assuming, of course, that the interpretation put upon these experiments is correct, even when the Ra is completely surrounded by a thickness of 4 cm. of Pb, a secondary radiation escapes, which has a value of λ approx. 1·25. Now it has been shown by Wigger (Jahrbuch der Rad. Band 2, '05) that practically all soft γ rays coming from the Ra are stopped by a thickness of Pb considerably less than 4 cm., and that the hard γ rays which can penetrate such a thickness have a value of $\lambda = 24$.

Again, the amount of the secondary radiation has only been reduced from 570 to 270 by the insertion of the 4 cm. plug of Pb, so that we must suppose most of the secondary radiation we are dealing with to be produced from the hard γ rays and very little of it from the soft γ rays. This result, it will be shown later, is supported by other experiments.

It is now possible to apply the necessary correction to the curve A, fig. ii. The result is shown by the full line curve C, the proper correction being obtained by adding a quantity $400(1 - e^{-(1·5 \times 1·25)d})$ to the original values. Part of the secondary radiation from the sides of the cone was in these experiments cut off by suitable Pb screens; the factor 1·5 is introduced to allow for the obliquity with which the rays coming from the sides of the cone cross the radiators.

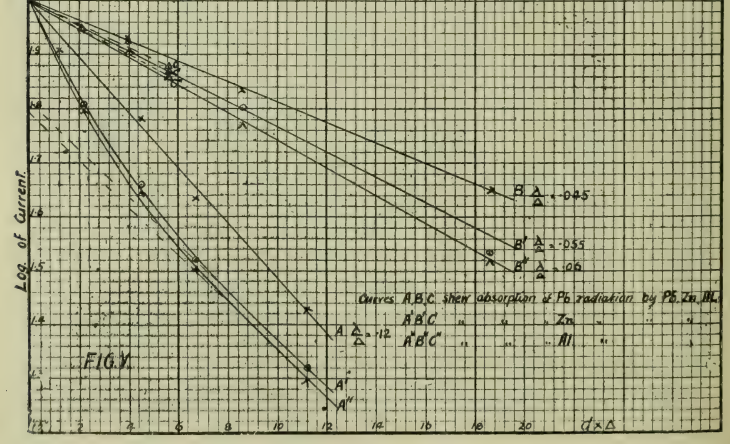


FIG. V.

In order to investigate now the quality of the secondary radiation which comes from the Pb radiators, a Pb plate 5 mm. thick was used as radiator, and the emergence radiation was absorbed by Pb domes. In each experiment the dome having been placed in position, two sets of measurements were taken, one with, the other without, the radiator, and the results of these subtracted. The mean of a number of experiments is shown in table i., and in fig. v., curve *A*, the value of the thickness of the dome multiplied by its density is shown horizontally, and the log. of the corresponding current vertically, the reading with no dome being reduced to 100. It will be seen that the emergence radiation from Pb, within the range of thickness of dome, over which it has been measured with sufficient accuracy, is approximately equivalent to a homogeneous radiation for which $\lambda = 1{\cdot}33$.

Now these results require correction on account of the absorption by the 5 mm. Pb radiator of the secondary radiation from the sides of the cone. As, however, this latter has been shown to have approximately the same value of λ, viz., 1·25, it is hardly necessary at the present stage to attempt to apply the correction.

The quality of the radiation from Pb was now tested by Zn and by Al domes. The results are shown in the curves *B* and *C*, fig. v. It will be seen that λ/Δ is of much the same value when the radiation is tested by Zn or Al; but is considerably greater when tested by Pb. This is similar to the results which are obtained when the original γ radiation coming from Ra, which apparently consists of a mixture of hard and soft rays, is tested by small thicknesses of absorbing screen.

TABLE I.

PB DOMES.

Radiation from Pb					
Thickness of Dome, mm. ...	0	1	4	6	10
...	100	80	60	43	26·5
Radiation from Zn					
Thickness of Dome, mm. ...	0	2	4	6	10
	100	64	46	33	21
Radiation from Al					
Thickness of Dome, mm. ...	0	2	4	6	10
	100	63	45	32	20

Zn Domes.

Radiation from Pb

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	85	67·5	44

Radiation from Zn

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	84	63	34

Radiation from Al

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	81	59	33

Al Domes.

Radiation from Pb

Thickness of Dome, mm. ...	0	8	21
	100	88	75

Radiation from Zn

Thickness of Dome, mm. ...	0	21
	100	74

Radiation from Al

Thickness of Dome, mm. ...	0	21
	100	72

It has already been shown that the radiation from the sides of the cone is approximately of the same quality as that from a Pb radiator; we may therefore assume without much possibility of error that the value of λ by Zn for this radiation is ·34.

It is now possible to apply the necessary correction to the curve A, fig. iii. A quantity $570(1-e^{-(1\cdot5\times\cdot34)d})$ has been added to the previous readings; the result is shown in the full-line curve B. The last two readings require a slightly less correction on account of the Zn plug cutting off some of the original γ radiation which produces the effect from the sides of the cone; the necessary correction in this case was determined by a separate experiment.

The quality of the emergence radiation from Zn and from Al was now tested by Zn and by Al domes. The results are given in table i., proper correction being applied in each case for the absorption of the radiation from the side of the cone.

The Zn radiator was 12 mm. thick, the Al 17 mm. Measurements were also made with radiators of other thicknesses, but the results were not sufficiently accurate to enable one to say whether the quality of the emergence radiation varied with the thickness of radiator.

The results are plotted in fig. v., from which it will be seen that the radiation from Zn and Al is far from homogeneous when tested by Pb domes.

The emergence radiation from Zn and Al appears to consist of two sets of γ rays—one of much the same quality as those which are produced from Pb, the other a very much softer bundle. A rough analysis of either the Zn or Al curve, if such is legitimate, would suggest that it may be derived from a hard and soft bundle of γ rays, for which the values of λ by Pb are 1·3 and 5 respectively, the effect of the hard bundle being initially almost twice that of the soft.

It will be seen from the figure that mass for mass Al and Zn domes are not able to bring out so clearly as Pb domes the distinction between the quality of the secondary radiations from Zn and Al as compared with that from Pb.

This, again, is much the same as is found when one attempts to sort out the original hard and soft γ rays of Ra by such screens.

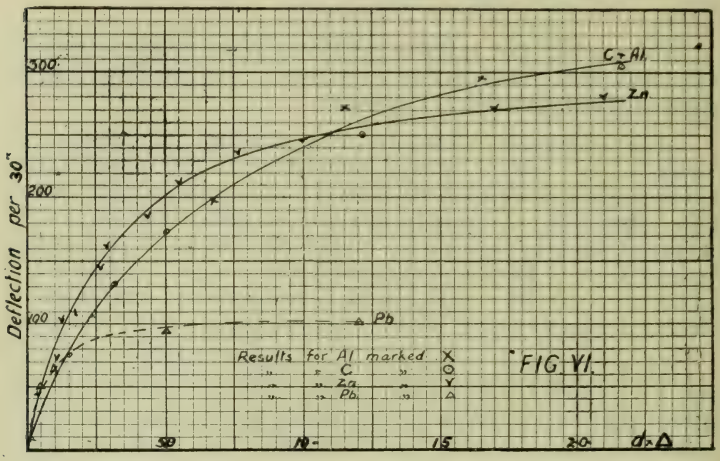
However, the radiation from Pb always appears somewhat harder than that from Zn and Al, no matter what screen is used.

This result has been checked on different occasions with care, and is of importance, as the results obtained by Kleeman from the secondary incidence γ rays, and the theory of selective absorption founded thereon, and extended to the original γ radiation, should apparently apply also to the secondary emergence rays.

§ II.

To investigate the secondary incidence γ rays the ionization chamber, fig. i., was inverted, and the large plates which served as radiators were laid directly upon the ionization chamber as at p,p. This enabled the secondary incidence rays from the radiator to enter the ionization chamber, not only by the sides i,i but also through the top of the chamber, and should more than compensate for any decrease in effect due to the primary γ rays falling upon a larger area than they did in the case where the emergence radiation was measured.

The secondary incidence radiation increased in amount as the thickness of the radiator was increased. In fig. vi. is shown the relation between the mass of the radiator and



the amount of the secondary incidence γ radiation for C, Al, Zn, and Pb.

C and Al give maximum values of nearly the same amount, viz., 300; Zn not quite so much, viz., 270; while Pb gave only 100. Comparing these with the corrected values for the emergence radiation from Pb and Zn respectively, which were 680 and 1400 approximately, it is seen that the lack of symmetry between the effects on the two sides of a plate is very marked—the effect on the emergence side being from about 4·5 to 6·5 times that on the incidence side. The quantities on the incidence side are consequently so small that they become difficult to measure with any great accuracy, especially when an attempt is made to determine the quality of the radiation.

To measure the quality of the incidence radiation the top of the ionization chamber was covered with a lead sheet about 1 cm. thick, from the centre of which was cut a circular hole 17·5 cm. diameter. One of the larger domes was then inverted and placed so as to intercept the radiation from the radiator, which was placed in the large circular hole just mentioned. A thickness of radiator sufficient to give the maximum effect was used in all cases. There appeared to be very little difference in the quality of the radiation re-

turned from C, Al, and Zn. A Pb dome 4 mm. thick reduced the effect to approximately 20 per cent., indicating a radiation for which the value of λ is 4, if we can suppose it homogeneous.

In the case of Zn and Al it will be seen from table i. that a 4 mm. Pb dome reduces the effect of the emergence radiation to about 45 per cent. There is thus a considerable difference in the quality of the emergence and the incidence γ radiations from these substances.

That the incidence radiation from these substances is softer than the emergence, is also supported by the experiments of Kleeman and Eve already referred to, both these observers having found the value of λ for the incidence rays from these or similar substances to be of the order 4, measured by Pb. In the case of the incidence radiation from Pb the measurements were not sufficiently accurate to decide whether the incidence radiation was softer than the emergence; it appeared to be of much the same quality, *i.e.*, $\lambda = 1{\cdot}3$ approximately.

§ III.

As the apparatus described in fig. i. was unsuitable for measuring the amount of secondary emergence radiation from substances such as Al and C, and as we do not know that the distribution of the emergence radiation is the same in all directions for all substances an experiment was set up as shown in fig. vii.

The lower portion of the diagram shows the arrangement of the Ra, magnet, and iron case which is the same as previously described. Some distance above the Ra was supported—upon an insulated stand—a flat cylindrical ionization chamber. The floor of this chamber was of sheet lead 1·25 mm. thick, the sides were of Zn, and for a lid was used a thin Al plate. The conical chamber, shown by dotted lines, was used in experiments to be described later. The radiators were in the form of flat plates, the first of which in any experiment was placed in the position p,p. Additional thicknesses were added immediately below p,p and in contact with the top plate, while for very great thicknesses plugs of the material could be inserted in the conical hole in the Pb block, through which the γ radiation streamed.

In the first set of experiments the Pb plates L,L were used in the position shown, the large central hole in them

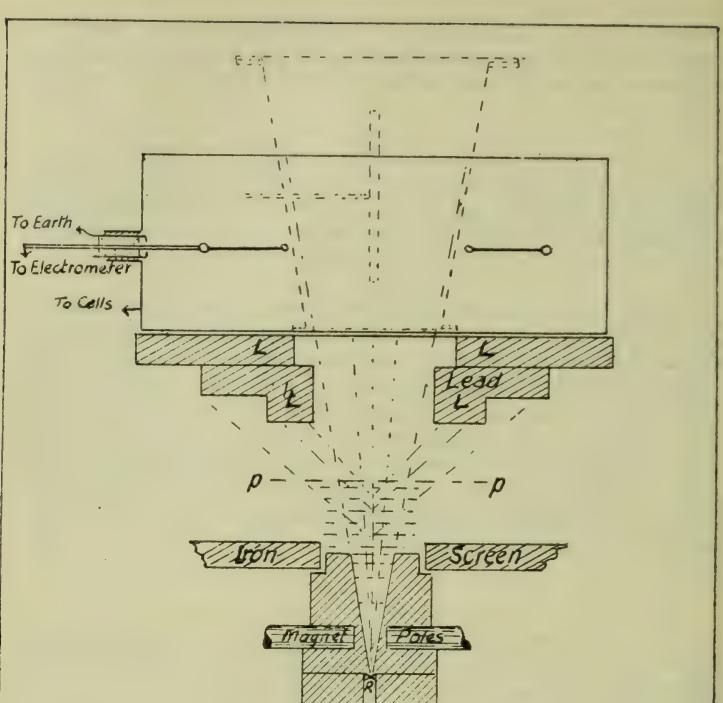


FIG. VII.

The radiators shown by horizontal dotted lines below p,p intercept the radiation from the Ra. By means of Pb plates L,L an amount of the secondary radiation may be prevented from entering the ionization chamber. The dotted conical chamber was used in a separate set of experiments.

allowing the γ rays to pass without obstruction to the ionization chamber; while a considerable amount of secondary γ radiation from the radiating plates p,p was prevented from reaching the chamber. A strong magnetic field was applied during the experiments. The floor of the ionization chamber, consisting of Pb 1·25 mm. thick, was sufficient, as has been shown in previous papers, to give the full amount of emergence β radiation. Several readings were taken with each thickness of radiator in position, and the readings were sufficiently large with the chamber filled with air. From any reading it is necessary to subtract an amount corresponding

to the leak produced by the natural ionization in the chamber, to the radiation which comes directly from the Ra and has not all been cut off by the interposed screens, such as L,L, and to secondary γ radiation from surrounding bodies, which may be able to enter the chamber. This latter quantity was found to be by no means negligible, and so far as I know has not been allowed for in many experiments by previous observers. To obtain with great accuracy the zero reading necessary for subtraction, is a course exceedingly difficult.

In the present experiment a close approximation to its value was found by inserting a large Pb plug in the conical hole and placing plates of Pb above this, so as to make in all a thickness of about 20 cm. This, as shown by previous observers, should be sufficient to reduce even the hard γ radiation, which streamed through the conical hole, to almost a negligible amount, while it should not affect to any great extent the secondary radiation coming from surrounding bodies.

The results of experiments with different materials used as radiators are given in table ii., and in fig. viii. are shown by full-line curves the thickness of radiator multiplied by its density, plotted horizontally against the logarithm of the corresponding currents vertically. The value of the current with no radiation in position at p,p has in each case been reduced to the common value 100, and the zero for the ordinates has in some of the curves been altered so as to prevent overlapping. It will be seen that Pb, Bi, and Hg give results almost identical; while Sn, Zn, Al, and C all give results very similar to each other, but differing from those of the first group in that a more sudden drop of the curve is shown for the initial thicknesses of radiator. From a value of $d\Delta = 7$ onwards the curves for all the substances become practically parallel.

The Pb screens L,L, fig. vii., were now removed, and radiators were used in the form of large, flat plates, the first of which was placed horizontally just below the floor of the ionization chamber, merely separated from it by a small thickness of ebonite for insulation.

Successive thicknesses of radiator were added immediately below the first. By this means it was thought possible to allow a large proportion of all the emergent secondary γ radiation to add on its effect in the chamber. The results

TABLE II.

LEAD FLOOR.

C		Al		Zn		Sn		Bi		Pb	
d	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*
mm.											
0·0	100·0	0·0	100·0	0·0	100·00	0·0	100·00	0·00	100·00	0·0	100·00
10·0	90·4	4·8	92·5	6·7	73·60	7·8	67·60	5·12	54·50	1·1	83·50
20·0	81·2	10·0	86·5	12·0	57·40	15·0	51·70	10·50	38·20	2·5	69·30
30·0	71·0	18·5	73·5	18·0	44·80	22·8	38·80	15·70	27·50	5·0	54·50
40·0	64·7	33·5	57·3	24·0	33·80	37·8	21·00	25·20	16·95	7·5	44·20
54·0	54·4	43·5	49·2	30·0	25·60	47·8	14·70	35·70	10·65	11·6	31·40
76·0	42·6	63·5	35·8	40·0	18·40	67·8	9·00	55·20	5·28	16·6	23·00
99·0	33·7	93·5	22·3	60·0	8·90	87·8	5·37			21·6	17·40
128·0	23·4	133·5	12·7	80·0	5·99	107·8	4·17			26·6	12·80
				100·0	3·78					36·6	8·10
										46·6	4·90
										56·6	3·64
										66·6	2·76

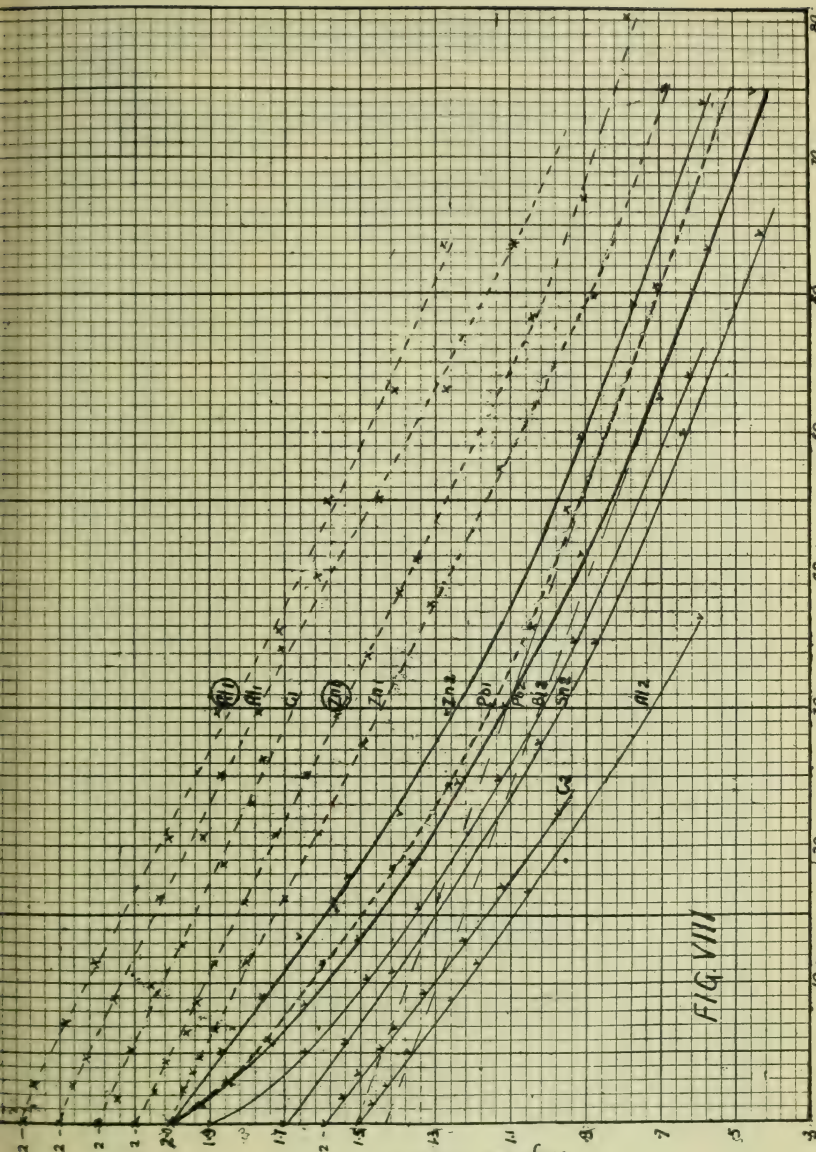

Log. of current
Δ x d (cms.)
FIG. VIII

TABLE III.

LEAD FLOOR.

Al		Zn		C		Pb		Fe	
d	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*
mm.									
0·0	100·00	0·0	100·00	0·0	100·0	0·00	100·00	0·0	100·0
10·0	94·00	3·0	92·50	10·0	89·0	1·10	84·00	22·0	50·7
17·0	85·50	4·5	87·60	30·0	83·0	2·55	71·20	S	
34·0	72·00	6·0	84·20	57·0	72·5	5·10	55·70	0·0	100·0
61·0	54·80	9·0	75·80	77·0	59·6	10·20	39·60	13·0	91·4
78·0	46·00	15·3	62·20	87·0	53·8	16·30	26·00	27·0	81·0
95·0	37·60	21·6	50·00	107·0	49·5	21·60	18·20	Hg.	
112·0	29·40	28·0	41·60	132·0	39·0	26·70	14·20	0·0	100·0
129·0	25·60	37·0	30·80	152·0	37·0	31·80	10·80	6·0	48·0
149·0	20·80	52·0	20·60			44·00	8·00	15·3	21·0
169·0	14·70	58·0	15·60			54·00	5·15	Sn	
199·0	10·30	64·0	13·30			64·00	3·40	0·0	100·0
239·0	6·15	72·0	10·15					25·0	46·0
		81·0	7·52						
		102·0	4·82						

CARBON FLOOR.

Al		Zn	
d	*I*	*d*	*I*
0·0	100·0	0·0	100·00
10·0	93·7	3·0	89·70
27·0	77·2	6·0	82·70
44·0	64·5	9·0	74·00
78·0	45·5	12·0	69·00
112·0	30·4	15·3	61·40
139·0	20·6	21·6	51·50
169·0	15·5	28·0	42·30
199·0	11·6	34·0	35·30
239·0	7·6	40·0	29·50
		46·0	24·10
		52·0	19·80
		55·0	18·10
		61·0	13·70
		67·0	11·30
		79·0	9·05
		91·0	6·45
		109·0	4·90

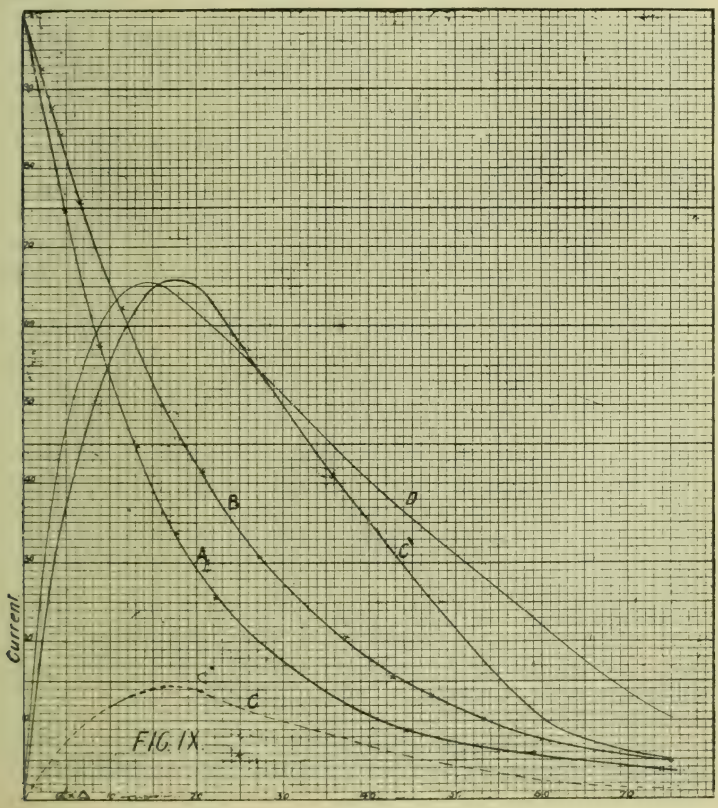
of these experiments, given in table iii. and shown by the dotted curves in fig. viii. show that this anticipation was realized.

The dotted curves (Al') and (Zn') need not be considered at present; they were obtained with a carbon floor introduced into the ionization chamber.

Al, C, Zn, Fe, S, and Sn give results which are all very nearly identical, and the curves show a considerable difference in slope to what they did in the previous experiment.

Pb and Hg, however, are distinctly different from the other substances, of which we may hereafter take Zn as typical.

The curve for Pb has not been altered to such a large extent by the change of arrangement of the experiment as has that for Zn and such substances.



The results for Zn are shown separately in fig. ix. by curves A and B, in which the values of thickness of absorbing screen multiplied by its density are shown horizontally and the corresponding currents vertically. The difference between the ordinates for any value of $d\ \Delta$ represents the amount of secondary radiation which it was possible to cut out by the Pb screens L,L in the first experiment. This difference is shown by the dotted curve C. It will be seen that the amount of secondary γ radiation increases with the thickness of absorbing screen or radiator, until a value corresponding to $d\Delta = 18$ has been reached, after which it gradually falls. For certain values of $d\ \Delta$ the effect produced by the secondary γ rays may be almost as great as that which is being produced by the primary γ rays.

It is thus seen that the effect produced in an ionization chamber in an ordinary absorption experiment depends largely upon the position of the absorbing plate relatively to the ionization chamber, and the shape of an absorption curve may consequently be made to vary between considerable limits. The shape of the chamber, however, appears to make very little difference to the shape of the absorption curve, within of course certain limits.

A conical ionization chamber, as shown by the dotted diagram in fig. vii., gave results for the first few thicknesses of radiator almost the same as those shown by the dotted curves, fig. viii.; while, again, with the plates placed at p,p results similar to those shown by full-line curves in the same figure were obtained, without of course the necessity of using Pb screen such as L,L.

This is readily explained if we remember that probably most of the effect produced in the ionization chamber is due to emergence and incidence β rays coming from the floor and lid of the chamber; these rays being the product of the original γ rays and of the secondary γ rays. The β rays as a result of the scattering they undergo emerge in all directions from the floor and lid of the chamber, and any alteration in the shape of the chamber will affect the ionization produced by the β rays, which come from the secondary γ rays to much the same extent as it will those which come from the original γ rays.

Returning to fig. viii. it will be found that the ordinary absorption curve, corresponding to the dotted curve Pb 1, *i.e.*, in which as much secondary radiation as possible is included, can be represented very accurately by the expression: $30e^{-\cdot 32d} + 70e^{-1\cdot 35d}$.

Again, the full-line curve Pb 2, from which as much as possible of the secondary radiation has been excluded, is re-

presented by the expression: $24e^{-\cdot 32d} + 76e^{-1\cdot 35d}$. The difference between these two expressions, viz., $6(e^{-\cdot 32d} - e^{-1\cdot 35d})$ is a measure, therefore, of the total emergence secondary γ radiation from Pb. Now it has been shown in previous experiments in this paper that the secondary γ radiation from Pb can be approximately represented by a homogeneous radiation, for which the value of λ is 1·25; we are, therefore, able to account for the results which have just been obtained if we suppose that the original hard bundle of γ rays, which proceed from the Ra, makes all, or, at least, very nearly all, the secondary radiation which comes from Pb; this is in agreement with the result obtained previously (page 169).

In the case of substances of the nature of Zn the difference between the two absorption curves, as shown in fig. ix., cannot be explained so simply. The secondary radiation after reaching its maximum value falls off more rapidly than we should expect, had all the secondary been derived from the hard set of original γ rays. We must suppose that in such substances the soft γ rays from the Ra also produce a certain amount of secondary emergence radiation, or that even though such may be produced in all substances it is better able to escape from such substances as Zn than from substances of the nature of Pb. This of course is merely another way of saying that Pb absorbs the softened secondary radiation to a much greater extent than Zn.

Again, it has been shown earlier in this paper that the emergence radiation from such substances as Zn appears, when tested by Pb, to be divisible into two quantities corresponding to a hard and soft bundle of γ rays, the hard having about the same penetrating power as the secondary rays from Pb. As it will be shown presently that there is good reason to believe that two distinct bundles of γ rays—a hard and a soft—are given out from the Ra, we may for the present look upon the two bundles of secondary rays which are produced from Zn and such substances as the products of the corresponding hard and soft bundles of the original radiation.

It will be seen from fig. viii. that when as much secondary radiation as possible is excluded the curves for all substances very nearly correspond. Let us suppose that had it been possible to exclude all the effects of secondary γ radiation, the curves for all substances would have become identical. This supposition must apparently be very near the truth, for it can be seen from the geometry of the arrangement in fig. vii. that by no means can all the secondary radiation have been excluded in the first set of experiments. We arrive, then, at this result: that, excluding all secondary γ

radiation and its effects, we may consider the Ra to give out two distinct sets of γ rays, one more penetrating than the other, each practically homogeneous, with values of $\lambda/\Delta = \cdot 028$ and $\cdot 012$ respectively, these values being practically independent of the nature of the absorbing substance.

When the secondary γ radiation is allowed to produce its effect in addition to that produced directly by the original γ rays, this law may be modified to a very considerable extent. In the usual arrangement of apparatus used for determining the quality of a radiation the absorbing plates are as a rule placed close to the ionization chamber, and the values of λ deduced from the tangent to the absorption curve —that is to say, it is generally with the dotted line curves of fig. viii. that we are dealing, and the effects of secondary radiation may, as has already been shown, be in some cases very nearly as important as the effects produced directly from the original γ radiation.

This, for example, affords a ready explanation of the effect observed by Eve (Phil. Mag., Aug., 1908), who states: —"It is noteworthy that the Ra in 2·2 cm. of nickel-steel gives an effect about 1·5 times as great as when the Ra is in 1 cm. of Pb. From the relative densities we should expect 2·2 cm. of steel to be equivalent to 1·5 cm. of Pb, and therefore the Ra in the steel cylinder should give, by the density law, two-thirds of the effect of the Ra in Pb. It actually gives one and a half times as much; thus the primary γ rays traverse steel much more readily than Pb, but the rays passing through iron are subsequently absorbed more readily by Pb than if the Ra were in Pb."

From the results of the present paper we can say that in going through 2·2 cm. of steel or 1·5 cm. of Pb, the soft primary γ rays will have suffered in each case the same number of collisions, but that the effect of a collision with an atom of Pb, or rather with the constituent of such an atom, is much more definite than in the case of substances of lower atomic weight; that in the case of Pb the collision has broken the original γ ray up, immediately sending out a β ray, or has so shattered the original γ ray as to make it easy for Pb to subsequently complete the process.

In the case of Zn, etc., the effect of the collision has not been so definite: much scattered γ radiation is produced, somewhat softened by the effects of collision, but still able to suffer further modification as a γ ray before being eventually broken up and sending out the β ray.

It must be noticed that in experiments upon the secondary incidence γ rays, such as have been carried out by Kleeman and by Eve, the nature of the secondary effect may be

modified to a very considerable extent if the Ra be covered directly by a considerable mass of a substance such as Zn. Where a similar screen of lead would appear to have hardened the primary beam which is being experimented with, the screen of Zn may very well appear in some cases to have softened the primary beam, more especially if the secondary effects produced by hard and by soft rays do not conform to the same law of distribution.

It may be observed that the value of λ/Δ obtained in the present investigation for the hard γ rays from Ra is ·028, whereas the mean value obtained by Wigger was ·021. The difference probably arises from the fact that Wigger appears to have taken the natural ionization in the chamber as the amount to be subtracted from all the readings. It seems quite possible that a considerable amount of secondary radition from surrounding bodies may have been able to enter the chamber, in which case the correction should have been greater, and this applied to all the readings would increase the value of λ/Δ which he obtained.

Again, since the hard γ rays produce a considerable amount of secondary radiation in Pb, it is not surprising that with a long, narrow chamber, such as Wigger used, the shape of the absorption curve for Pb differs from that obtained in the present experiments.

We have now sufficient information to enable us to construct at least a working theory. The main points to be observed are, firstly, the lack of symmetry in the amounts, and, secondly, a lack of symmetry in some cases in the quality of the secondary γ radiation.

The asymmetry shown by the secondary emergence and incidence β rays, which are produced from the primary γ rays of Ra, has already been put forward as an argument in favour of the "material" theory propounded by Professor Bragg.

The modification of the ether-pulse theory, recently advanced by Professor J. J. Thomson, may possibly furnish a partial explanation of the facts: but there are many difficulties in the way of a pulse theory, even modified to this extent: some of these have been pointed out in a recent paper by Professor Bragg and myself (Trans. Roy. Soc., S. Aus., v. xxxii., 1908).

When one attempts to further explain by the pulse theory the lack of symmetry which exists in the case of the secondary γ rays, the difficulties become much greater.

If we are to suppose that the incidence and emergence γ rays are true secondary effects produced by vibrations of electrons in the absorbing material, the effect resembles very

closely that of fluorescence. The corresponding optical problem, however, gives rise to no such lack of symmetry; we find in its case no corresponding asymmetry of distribution or of quality of the secondary effect.

If, however, we attempt an explanation upon the "material" theory, these difficulties at once disappear.

Let us consider in the first place the effects produced by a homogeneous bundle of hard γ rays. These in passing through matter suffer collision; the effect of such collision is to change the direction of motion of the incident primary ray--in other words, to scatter it; at the same time the scattered ray loses a certain amount of energy—it has become softened; this softening may be due either to a change in its speed or to a change in moment of the γ pair, or it may be both. The distribution of the scattered radiation will probably depend upon the nature of collision, and may be influenced largely by the atomic structure of the matter with which the γ particle has collided. We have seen, for instance, that in the case of Pb, where the secondary radiation is produced mainly from the hard bundle of γ rays proceeding from the Ra, that much more of the scattered γ radiation moves on in the direction of the original rays than returns in the opposite direction.

Consider the case of a fine stream of homogeneous rays moving in the direction x, a plate of absorbing material of thickness L being placed in their path, at right angles to the direction of motion of the particles. Let $I_\circ$ be the number of γ particles which are sent out by the Ra per unit time. The number I which are able to proceed a distance x through the absorbing plate without suffering appreciable effect is such that $I = I_\circ e^{-\lambda x}$. In a distance, dx, the number which have suffered serious collision is $I_\circ \lambda e^{-\lambda x} dx$. Of these let a fraction, q, be merely scattered, at the same time softened or reduced to what we may call an intermediate stage, in which their coefficient of absorption (so called) is λ'.

The remainder represented by the fraction $(1-q)$ are turned into β rays at once. Let $i_\circ = q I_\circ \lambda e^{-\lambda x} dx$.

As a result of scattering in a direction inclined to the original at an angle θ, let $i_\circ F\theta$ represent the number of particles per sec. which cross the unit area of a spherical surface of unit radius described with centre at the point where scattering occurs; then the number of scattered rays which emerge per sec. from the flat plate of thickness L

$$= \int_\circ^L \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} 2\pi \, Sin.\, \theta . F\theta . q\, I_\circ \lambda \, e^{-\lambda x} \, e^{-\lambda'(L-x)\, Sec.\, \theta} \, d\theta \, dx$$

In addition to these rays we have emerging per sec. a number $I_0 e^{-\lambda L}$ which have suffered no scattering.

We are not at present able to evaluate the expression given above, from want of knowledge regarding $F\theta$. However, we may proceed to make an approximate calculation of the effect which might be expected in such a case as we have investigated in fig. i.

Considering as before a fine pencil of homogeneous γ rays falling normally upon a plate of thickness L, we may express the emergence radiation as—

$$k I_0 \lambda \int_{e}^{L} e^{-\lambda x} \; e^{-\alpha\lambda'(L-x)} \, dx = \frac{K I_0 \lambda}{\lambda' - \lambda} \left(e^{-\lambda L} - e^{-\alpha\lambda' L} \right)$$

where k is a constant, λ the coefficient of absorption of the primary set of rays, λ' a similar coefficient for the secondary rays, and α a constant obliquity factor, which in the present case is taken as 2, a value obtained by considering the geometrical arrangement of the radiators in fig. i. with regard to the ionization chamber.

Let us now apply this result to the case of a Pb radiator: the values of λ and λ' are ·32 and 1·3 respectively. The curve corresponding to $e^{-\cdot 32L} - e^{-2\cdot 6L}$ is shown by the dotted line in fig. ii., the maximum having been adjusted to the same value as for the experimental curve.

The agreement between the theoretical and the actual curve is very good.

The maximum value is reached for about the same thickness of radiator, and for thicknesses of radiator greater than that required to give the maximum effect the curves slope away to about the same extent. This, taken in conjunction with previous experiments, seems to show that practically all the secondary γ radiation obtained in these experiments from Pb may be considered as derived from the original hard γ rays of the Ra.

It must, however, be remembered that the secondary emergence rays have to penetrate the Pb sides of the ionization chamber, and allowing for obliquity this corresponds to a thickness of about 2 mm., so that it is still quite possible that a fair amount of very soft secondary γ radiation may have escaped detection.

If we now proceed in a similar manner to construct the corresponding curve for Zn, viz., $e^{-\cdot 21L} - e^{-\cdot 64L}$, it is found that it by no means corresponds to the experimental curve. If, however, we assume that for a thickness of about 10 cm. of the Zn radiator the primary soft bundle is producing very little of the secondary emergence γ radiation, the curve as

calculated above may be placed in the position shown by C, fig. iii. The curve D is now drawn to represent the difference between the curves B and C. We may now see how closely this remainder corresponds to what might be expected if the soft bundle of original γ rays produced a corresponding softer secondary. The maximum in the case of this remainder curve is further to the left than in the case of curve C, and after reaching its maximum value the curve falls away much more rapidly than does C. It corresponds, in fact, very well with what we might reasonably expect to be produced by the soft bundle of γ rays coming from the Ra. Again, although for any given thickness of radiator the ratio of the ordinates to the curves C and D is by no means constant, it is of the order indicated in fig. v. by the curve A''.

If, now, the curves C and D represent the effects due respectively to the hard and soft γ rays from the Ra, it should be possible to show experimentally that the quality of the radiation from a Zn radiator depends to some extent upon the thickness of the radiator. No serious attempt has so far been made to carry out this investigation. However, we may check the result in another way. The quality of the radiation from Zn should show some change if we absorb some of the soft γ rays coming from the Ra by means of a Pb screen or plug before allowing the radiation to fall upon the Zn radiator. As we have already seen, it is possible in this way to reduce the softer radiation without cutting down the hard to such an extent as would be necessary if a plug of material such as Zn were used.

Using 17 mm. of Al as radiator, with no plug, the reading with no dome was to the reading with a 6 mm. dome as 100 : 31. With a 9 mm. plug, however, inserted in the conical hole just over the Ra the reading with no dome was to the reading with a 6 mm. dome as 100 : 39. A similar effect was also obtained with a Zn radiator.

We see, then, that hardening the primary radiation has the effect of hardening the secondary, and this is in agreement with the suggestion put forward, viz., that in the case of Zn, Al, and such substances the secondary emergence γ radiation consists of two bundles corresponding to, in fact derived immediately from, the two corresponding bundles constituting the original γ radiation.

In fig. ix. the dotted curve C has been plotted to a larger scale, and the curve D obtained previously in fig. iii., and shown in that fig. curve B, has been plotted with the same maximum value as C' for comparison with it. It will be noticed that the curve D *reaches* its maximum for a smaller thickness of radiator than does C'. This we might expect

as the secondary rays will be able to emerge from a greater depth of the radiator, when some of them come out more normally, as happens in the case represented by curve C'.

In the experiment from which the curve D is derived the rays emerge very obliquely, and their self-absorption by the radiator is much greater for a given thickness of radiator.

Otherwise the curves are in very good agreement. It is to be noticed that in curve C' certain effects may show themselves which are probably not present to such a large extent in the case represented by D. Soft radiation, for instance, has a much better opportunity of producing its effect in the former case.

Returning now to a brief consideration of the secondary incidence γ radiation. Although no attempt has as yet been made to determine whether the radiation from different substances is strictly homogeneous, it was thought advisable to find out how its amount varied for any substance as the Ra was covered with different screen thicknesses of Pb.

In these experiments C, Zn, and Al showed much the same effect. With no plug, a 5 mm. plug, and a 10 mm. plug over the Ra, the corresponding readings were as 100 : 60 : 35. Now, since the value of λ for the soft γ radiation from Ra is 1·35 for Pb, it should have required about 8 mm. of Pb to reduce it to 35 per cent. of its original value, and had the incidence secondary radiation been due entirely to the original soft γ rays it should apparently have been reduced to much the same amount. It is shown above that 10 mm. of Pb, placed in the path of the primary, reduces the secondary effect to 35 per cent., so that it appears that very nearly all the secondary incidence γ radiation from Zn and such substances is derived from the soft bundle of primary γ rays.

In the case of the radiation from Pb the measurements could not be performed with any great accuracy. However, it was found possible to place a 2 cm. Pb plug over the Ra without cutting off all the incidence radiation: the reading was reduced to about 30 per cent.

The experiment is accurate enough to enable us to say that the secondary incidence radiation from Pb is derived to a large extent from the original hard bundle of γ rays: its quality, as tested by Pb domes, shows also that it is of much the same nature as the emergence radiation, which appears to be the product of the hard γ rays.

In all these experiments, and especially in those which deal with the incidence radiation, it must be borne in mind that the radiation has to penetrate a thickness of Pb, cor-

responding to 2 mm. before its effect is measured, and consequently the effect of very soft γ radiation may have been missed.

The lack of symmetry in quality of the emergence and incidence radiation from some materials may be explained if we suppose the distribution of the scattered radiation which is produced from the hard γ rays is not the same as for that produced from the softer rays. The secondary radiation produced from the hard γ rays appears to move on more in the direction of the original stream than do the secondaries produced from the softer rays.

The distribution of the secondaries may also to some extent depend upon the nature of the medium in which scattering has taken place, and it does not seem at all unlikely that the atomic structure of the radiator should determine to some extent the nature and result of a collision between the γ particle and the constituent part of the atom.

It has already been stated that these experiments give little or no support to the theory of selective absorption advanced by Kleeman; the effects seem much simpler than we might be led to suppose from that theory. It seems possible, also, to suggest probable causes for the effects which Kleeman has observed. In some cases the absorbing screens used by Kleeman seem not to be of sufficient thickness to preclude the possibility of a certain amount of β rays, given off by the radiator, penetrating the screen. Secondly, it has been assumed that the incidence γ radiation from all the substances experimented with is homogeneous. If, for example, the incidence radiation from Pb contained a very soft bundle in addition to the hard, many of the results obtained by Kleeman could be immediately explained. With the present form of apparatus I have not of course been able to test this point; it does not, however, seem at all improbable that Pb should give out an exceedingly soft bundle of γ rays, the product of the soft γ rays in the original radiation; indeed, if it is safe to make comparisons from the behaviour of such substances as Zn, it would be surprising if such a soft bundle did not exist, although of course its effect may be small. Thirdly, in dealing with the very soft γ rays, which constitute the secondary incidence radiation, it seems necessary to take into account the effect of tertiary radiation.

In conclusion it may not be out of place to discuss one or two points of some interest which have arisen during the progress of these experiments.

In fig. viii. it will be observed that for a mass of absorbing screen 70 the result of cutting out a considerable amount of the secondary radiation has been to change the

value of the effect produced with Zn screens from 56 to 43. In the case of Pb the corresponding change is from 38 to 30. In other words, the ratio of the effect produced by a Zn screen to that produced by a Pb screen of the same mass is apparently much the same whether secondary radiation is included or not. It appears almost as if the effect produced in the ionization chamber were due more to the secondaries produced from the hard γ rays than to direct effects of these hard γ rays. The hard γ rays are not apparently broken up as the result of the first collision; a few may be, but most of the rays seem capable of passing into what we may for convenience speak of as an intermediate stage. A second collision when the ray is in this stage may be more effective in breaking up the γ ray and causing the β particle to be sent out. In some cases the γ ray may still retain the characteristics of a γ ray even after many collisions.

It would seem possible for a γ ray to produce some ionization in a gas as a result of its passage through that gas, slow-speed delta rays being produced from the atoms of the gas. Where high-speed electrons appear they are to be considered as having been produced from the γ ray itself, being originally a part of it, as already suggested by Professor Bragg.

It has been found by Eve (Phil. Mag., 1906) that the γ rays from Thorium have an absorption curve, measured by Pb, very nearly the same as that for Ra. We should expect, then, that Thorium gave out two homogeneous sets of γ rays as does Ra, the values of λ by Pb for these groups being ·32 and 1·35. It has also been found by Eve that the value of λ for the γ rays given out by Ur is 1·4, and that these rays appear nearly homogeneous. The γ rays of Ur appear, then, to correspond very closely with soft bundle of rays emitted by both Th and Ra.

Again, it seems rather striking that the secondary rays produced by the hard γ rays of Ra produce in Pb, and apparently in all substances, a secondary, for which the value of λ is of the same order as for the Ur rays and the soft rays of Ra and Th.

In the case of the secondary rays produced from the hard γ rays of Ra it has been possible to treat them as practically homogeneous over the range of thickness of screens which have been used. It will, however, require much more careful research to determine the exact quality of this radiation.

Again, the value of λ/Δ for the soft primary bundle of rays has been shown to be nearly four times that of the hard. It seems possible that this may have some connection with the result obtained previously by Professor Bragg and

myself for the β rays which are produced from the γ rays of Ra. It was found that the value of λ for the hard and soft β rays was approximately as one to four.

Summary.

1. The γ rays of Ra and probably of Th appear to consist of two distinct homogeneous bundles, the value of λ/Δ for the soft set being approximately four times that for the hard.

2. For each set of rays the value of λ/Δ is constant and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded.

3. Secondary γ radiation appears on both sides of a plate which is penetrated by a stream of γ rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides.

4. A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides.

5. The last results seem very difficult to reconcile with a pulse theory. On the "material" theory propounded by Professor Bragg no such difficulty arises.

6. The secondary γ radiation appears to be derived from the primary by a process of scattering. This process generally involving a reduction in the subsequent penetrating power of the ray affected.

7. There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered; also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight.

8. The absorption of γ radiation which has already passed through a thickness of one substance by screens of a different substance may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens.

In conclusion, it is a pleasant duty for me to acknowledge my indebtedness and sincere thanks to Professor Bragg for his keen interest and advice during the progress of these experiments.

University, Adelaide,
Sept., 1908.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part VIII.

By Jos. C. Verco, M.D., F.R.C.S.

[Read June 2, 1908.]

Plates XI. to XIII.

Emarginula subtilitexta, n. sp. Pl. xi., figs. 6, 7, 8.

Shell ovate, rather thin, white. Apex well curved, one-sixth of the length from the posterior end. Convex anteriorly from apex to margin; posteriorly concave below the apex, then convex, then somewhat spreading near the margin. Slit narrow, margined by a low thin erect lamella. Posterior two-thirds closed; closing callus sunken, scalloped with transverse erect lamellæ convex towards the apex. Sculpture: 60 radial ribs, low and flatly rounded, about one-half as wide as the interspaces, projecting beyond and crenulating the margin. Concentric narrow erect lamellæ rather crowded cancellate the surface. Interior smooth and white.

Dim.—Length, 6·5 mm.; breadth, 4·9; fissure, 1·4 mm.; height, 2 mm.

Locality.—110 fathoms, off Beachport, 1 dead.

Diagnosis.—*E. superba,* Hedley, has the same number of radial ribs and the dentate margin, but has higher concentric lamellæ. *E. dilecta,* A. Adams, has a similar sunken scalloped slit fasciole, and nearly the same number of radials, rather more; but has ruder ribs wider than their interspaces.

Puncturella (Cranopsis) corolla, n. sp. Pl. xi., figs. 1 to 5.

Shell thin, roundly oval, depressed conic. Apex eccentric, one-fifth of the length from the posterior end, spiral, well curved backwards. Protoconch projects on the right side and consists of two whorls, the first turn and a half are smooth, convex, glistening; the second half turn, which increases rapidly, is minutely crowdedly granular; at the junction of the two is a minute scar, the first part fitting into the second. In the adult shell the latter part of the protoconch looks directly backward. The sculpture of the shell begins gradually as accremental wrinkles, and next as radial riblets. Where the wrinkles commence the slit begins. The dorsum in front is a uniform convex curve, behind it is a continuous concave curve. The perforation occupies the middle third of the dorsal slope, and is lanceolate. Between it and the

protoconch its previous site is closed by a sunken lamina with subdistant erect transverse lamellæ, convex posteriorly. Between it and the anterior margin is a differentiated rib, broader and higher than the rest, fissured superficially throughout. In its upper part the fissure is as wide as the perforation, but is nearly closed internally by horizontal laminæ from the sides. It gradually contracts anteriorly to a fine line; in its upper half the fissure communicates with the interior, in the lower it is shut off. The slit fasciole and perforation are bounded on each side by a delicate erect lamina, highest at the perforation, in front of which the laminæ gradually approximate to form the differentiated rib. From the protoconch to the margin this lies a little to the right of the actual median line of the shell. Sculpture: Radial ribs, well rounded, nearly smooth, about as wide as their interspaces, sixteen primary, but increasing rapidly by intercalation of secondary and tertiary riblets to 90 in a shell of 10 mm. length, and crenulating the margin. These riblets appear first as gradually enlarging tubercles in the centre of the intercostal spaces, situated on the concentric laminæ, which conspicuously cross the interspaces, slightly scale the bases of the ribs, but are barely visible under the microscope on their summits. They produce radial lines of punctations in the interspaces, and in old dead specimens, where the glaze disappears from the interior, these appear as perforations. The ribs posteriorly are broader and closer together. Internally a small shelf or septum convex towards the interior, with a sharp simple margin anteriorly hides the upper fourth of the perforation, being attached to the shell at a distance from the margins of the perforation about equal to the width of the perforation; it gets gradually narrower and less obvious posteriorly. Its dorsal surface slopes up to the slit fasciole, the last one or two scales of which roof in the back of its cavity. From the perforation anteriorly runs a gutter to the margin; in older examples this becomes a thin central ridge. Shallow radial furrows correspond with the external ribs. As individuals get older, the shell grows more rapidly posteriorly, so that the apex gets less eccentric, and the back part becomes very flat and sloping.

Dim.—When half-grown, length, 10 mm.; width, 8 mm.; height, 1·4 mm.; apex, 1·8 mm. from the posterior end. When full-grown, length, 18 mm.; width, 15·4 mm.; height, 4·7 mm.; apex, 5·4 mm. from the posterior end.

Locality.—130 fathoms, off Cape Jaffa, 20 whole or broken; 300 fathoms, 4, all dead.

Obs.—The shell appears to fall within the limits of *Cranopsis*. I have no shells of this genus with which to com-

pare it, and the illustrations in Tryon's "Manual" are very small; but the perforation on the slope and the internal septum coincide with its definition. One can see in different individuals the varied aspects of the shell at successive stages, first a depressed spiral shell with a simple aperture; then an emarginula-like form, with a slit and slit fasciole; then a rimula-like shell, with a perforation just above the margin, continued as a narrow fissure to the border, and finally with the fissure closed and the perforation complete.

Modiola projecta, n. sp. Pl. xiii., figs. 12 and 13.

Shell solid, narrowly oblong, inequilateral. Umbo directed forward at the junction of the first and second fourth of the shell, approximate, round, inflated. Anterior dorsal margin with a uniform rounded slope, commencing just behind, and within the apex of the umbo, over the front of which it is reflected. Posterior dorsal margin straight, very gently convex. Anterior end round; posterior end sloping convex. Post-dorsal angle a very obtuse curve, post-ventral angle a much smaller curve. Ventral border nearly straight, slightly concave, almost parallel with the dorsal borders. Margin simple, smooth. A groove increasing in width runs from the umbo backwards within the post-dorsal border for three-quarters of its length, formed by a stout, projecting internal lamina, which widens for half its length, and then gradually dwindles. The posterior muscle scar is rather deep. Of the two oblique umbo-ventral ridges the anterior is the more distinct. Externally there are obsolete accremental striæ, and in the earlier stage distant, rounded, low, concentric ridges, more marked towards the front. Traces of a dark epidermis are present.

Dim.—Antero-posterior diam., 10·9 mm.; umbo-ventral, 4·1 mm.

Locality.—Off Beachport, 200 fathoms. One right valve.

Modiolaria semiradiata, n. sp. Pl. xiii., figs. 14 and 15.

Shell oblong-ovate, ventricose. Umbo terminal, flattened, directed forward, applied to the front end of the shell. Post-dorsal border straight, short, thin, then faintly curved. Posterior end round; ventral border straight, anterior end round. Margin crenulated on the edge, with rounded teeth along the curved part of the post-dorsal border and at both ends. The ventral border shows no teeth, but probably because it is a little eroded. A narrow oblique furrow runs between the apex of the umbo and the adjacent front margin of the shell. An inflated ridge runs from the umbo to the posterior end, steep on the dorsal side, and gently sloping on the ventral.

Accremental striæ irregular in distance and size mark the surface, and form rude flat concentric ridges at intervals. Well-marked radial striæ cover all the posterior half of the shell, extending from the umbo to the ventral border, somewhat interrupted at the edges of the concentric ridges; these are quite absent from the anterior half.

Dim.—Antero-posterior diameter, 8·9 mm.; umbo-ventral, 5·2; sectional of one valve, 3·5 mm.

Locality.—Cape Jaffa, 130 fathoms, one valve.

Arcoperna scapha, n. sp. Pl. xii., figs. 1 to 5.

Shell small, solid, white, oval. Umbos terminal, round, inflated, directed slightly forward, approximate but not in contact. Prodissoconch very distinct, separated definitely from the dissoconch by a fine groove; its earliest third is quite smooth, its later two-thirds engraved with concentric lines, gradually growing more valid. Post-dorsal border nearly straight for 1·7 mm., forming an open rounded angle with the posterior border, which is nearly straight for 1·7 mm., then sweeps with a slight convexity into the short-curved, circular, ventral border. The anterior dorsal border is very short, almost entirely under the umbo. The antero-ventral border is slightly convex. The whole dorsum is engraved with crowded, slightly-curved, radial lines, latticed by concentric lines nearly as valid; some of the latter at distant intervals in the early stages of growth are much deeper, so as to form slightly imbricating ledges. The inner margin of the shell has fine denticulations from the end of the post-dorsal border all round and almost to the central extremity of the anterior dorsal border under the umbo; they do not reach the outer edge of the shell. The straight edge of the prodissoconch is set somewhat obliquely to the anterior dorsal border, the central extremity of which extends slightly behind the centre of the edge of the prodissoconch. The post-dorsal line is provided with many (more than 20) close-set, low, vertical teeth on its inner surface. Beneath them is the scar of the ligament for the anterior three-fourths of their extent, somewhat increasing in width posteriorly, and having a rounded end. It seems to pass out between the prodissoconch and the anterior dorsal hinge-line to become external. The anterior dorsal border has a few denticulations and one tooth, and is supported by a sort of thickening which projects slightly into the cavity of the shell and has a rounded central end. Two elongated muscle-scars occupy the middle third of the sides of the shell, not far from the margin, narrowing dorsally; the posterior is rather the larger.

Dim.—Antero-posterior diameter, 3·2 mm.; umbo-ventral, 4·5; sectional of closed valves, 3·6 mm.

Locality.—Off Beachport, 49, 100, 110, 150, 200 fathoms; off Cape Jaffa, 90 and 130 fathoms; off Cape Borda, 55 fathoms; east of Neptunes, 45 fathoms. Only one living specimen was taken in 45 fathoms. Valves were secured in numbers, chiefly between 45 and 110 fathoms; beyond this depth they were few. Mr. Hedley reports to me that it has been taken in 80 fathoms, 22 miles east of Narrabeen, New South Wales.

Diagnosis.—It somewhat resembles *Crenella globularis*, Tate, a tertiary fossil; but this is a wider shell comparatively, and more symmetrical.

The generic location of this shell has been somewhat difficult, and Mr. Hedley and Mr. Etheridge and Mr. Kesteven have compared it with allies in the Australian Museum, Sydney, and discussed its characters, and as a result it has been placed in *Arcoperna*, and becomes a second recent Australian species of this previously fossil genus, the first, *A. recens*, having been figured and described by Tate in Journ. Mal. Soc., Lond., 1897, p. 181.

Leptothyra carinata, n. sp.

Figured in Trans. Roy. Soc. of S. Austr., vol. xxxi., 1907; pl. xxix., fig. 8.

Shell minute, solid, three and a half whorls. The first two whorls are smooth, white and convex. The spire-whorl shows three rounded carinations, one just below the suture which is channelled by it, the second about one-third the distance between the sutures, and the third about one-fourth the distance from the lower suture. The interspaces are concave, and have spiral cords, equidistant; two in the upper space, the posterior the smaller; three in the middle space, small and equal. The body-whorl has seven carinations which become gradually lower towards the base, and closer; interspaces concave, and provided with spiral liræ, varying from six to two, according to the width of the spaces. The lowest carina forms a margin to the umbilicus which is wide and sculptured with about eight spiral liræ. The spirals are cut up at irregular intervals by radial incisions, and marked by very fine crowded microscopic radial scratches. The aperture is circular; its inner surface smooth, and its outer scalloped by the spirals. Colour, very light amber; some examples are white, others faintly tinged with pink

Dim.—Largest diameter 1·4 mm., smallest 1 mm.; height 1·1 mm.; width of aperture, ·7 mm.

Locality.—20 fathoms, outside Backstairs Passage, with six other examples, dead.

Diagnosis.—From *L. arenacea*, Pritchard and Gatliff; in its marked carinæ, more widely canaliculated suture, and wider umbilicus. From *Liotia alazon*, Hedley, in being a smaller shell, with less valid carinæ, and in its radial incisions.

Cuspidaria dorsirecta, n. sp. Pl. xi., figs. 9 and 10.

Shell small, moderately solid, oval, equilateral. Umbo prominent, acute, prosogyre. Post-dorsal line straight; anterior concave in front of the apex, then straight; the front end uniformly widely curved, ventral border gently curved, with very slight incurving at the base of the rostrum, which is very short and wide. Well-marked granulated ridge from the umbo to the postero-inferior angle of the rostrum; a second ridge cuts off its upper fourth. In front of the former is a moderate depression. Surface smooth but for sublenticular accremental striæ. It has one anterior and one posterior lateral tooth well developed, roundly-triangular; the latter slightly the larger, and from its end a very low but gradually rising lamina is continued nearly to the end of the rostrum, and forms a narrow, slightly-widening groove with the dorsal margin.

Dim.—Antero-posterior diameter, 5 mm.; umbo-ventral, 3·3 mm.

Locality.—Off Beachport, from 40, 100, and 110 fathoms; off Cape Borda, 60 fathoms; valves.

Cuspidaria alta, n. sp. Pl. xiii., figs. 8 to 11.

Shell small, thin. Umbo tumid, blunt. Anterior dorsal border very faintly convex sloping; posterior dorsal border concavely sloping. Anterior end sharply rounded; posterior moderately and broadly rostrated. Ventral border uniformly widely arcuate, running concavely into the rostrum. An oblique, gradually-widening depression between the body and the rostrum, and an oblique ridge between its lower angle and the umbo; there is a second ridge close to the median line, the intervening space nearly flat. Outer surface smooth, but for sublenticular concentric striæ, which are much more marked on the rostrum. Right valve with an anterior and posterior triangular lateral tooth, the latter the larger, and its groove running some distance into the rostrum. Left valve edentulous, and lies within the margin of the right. The pallial line ends by a nearly vertical curved line from the umbo.

Dim.—Antero-posterior diameter, 6·8 mm.; umbo-ventral, 4 mm.

Locality.—Off Beachport, in 100 fathoms, 1 valve; 150 fathoms, 2 valves. Off Cape Jaffa, in 90 fathoms, 20 valves; in 130 fathoms, 1 valve. South-west of Neptunes, 104 fathoms, 3 alive and 26 valves.

Cuspidaria angasi, E. A. Smith.

Neæra angasi, n. sp., E. A. Smith, Chall. Zool., vol. xiii., 1885, p. 47. pl. ix., f. 2. *Type locality.*—Sta. 164B, off the coast of New South Wales, 410 fathoms, green mud.

Dredged in 130 fathoms, off Cape Jaffa, 2 alive, 1 dead, 3 valves.

The ventral border and the lower border of the rostrum of the right valve lie within the margin of the left valve, while its dorsal borders, anterior and posterior, extend beyond those of its fellow.

Cuspidaria exarata, n. sp. Pl. xii., figs. 6 and 7.

Shell ovately-pyriform, subequilateral, thin. Umbo round, inflated, directed backwards. Anterior dorsal margin slightly convex; front end with a round, uniform curve; ventral border gently arcuate, joining the rostrum with a short incurvation. Post-dorsal slope nearly straight, barely incurved; rostrum short, slightly tapering. Fossette small, directed obliquely backwards. Right valve has no distinct tooth, but a low lamina runs from the fossette backwards for half the length of the posterior slope, to make a shallow, narrow furrow with its slightly more projecting border. The anterior dorsal slope is bevelled on its inner side, and has the trace of a furrow within it near the fossette. Interior glistening, smooth, white, with subdistant radial translucent lines ending at the simple pallial line. Externally about twenty triangular concentric ribs, with sharp lirate summits and sublenticular concentric striæ on their sides; the ribs become less costate and more lamelliform towards the ventral margin, and at the depression in front of the rostrum, over which they are only irregular vertical striæ. Colour dull opaque white, with faint axial less white striations.

Dim.—Antero-posterior diameter, 13·2 mm.; umbo-ventral, 7·5 mm.

Locality.—35 miles south-west of Neptune Islands, in 104 fathoms, one right valve perfect and the posterior half of a left valve, which if whole would be half as large again as the type.

Diagnosis.—It closely resembles *C. trailli*, Hutton, as figured by Mr. Hedley in Trans. N.Z. Institute, vol. 38, 1905, p. 72, pl. ii., figs. 9, 10, 11, dredged in 110 fathoms, east of the Great Barrier Island. It is also about the same size, mine

probably varying from 13 to 19 mm.; his example was 15 mm. Three differences appear. My species is more concave along the post-dorsal border, shows only bare traces of umbo-rostral liræ, and has no teeth in its right valve projecting beyond the vertical plane. Mr. Hedley tells me he has the same shell from 250 fathoms, off Sydney.

Cuspidaria (Cardiomya) pinna, n. sp. Pl. xiii., figs. 5 to 7.

Shell squarely oval, ventricose, rather thin, umbos inflated, rounded, approximate. Front dorsal border short, straight, scarcely convex, joining by a rounded slightly obtuse angle the straight barely incurved anterior end. This with a faint angulation joins the open-curved ventral border, which, after a definite incurvation, unites with the lower border of the rostrum. The post-dorsal border is feebly-concave to the end of the rostrum, which is rounded at its rather attenuated end.

The sculpture is very bold. Three distant valid round ribs curve from the umbo to the posterior third of the ventral border. In front of these are about seventeen subequal less prominent rounded ribs, equal in width to their interspaces. Behind them are two rather distant, less valid ribs, and three more extend from the umbo to the end of the rostrum. All these ribs furrow the inside of the shell, and all crenulate or scallop the ventral border in the ratio of their size and distance. The border of the rostrum is not scalloped. There are microscopic accremental striæ, most marked and erect towards the end of the rostrum. Immediately beneath the umbo is a small triangular cartilage pit, wider than high. In the right valve is a triangular laminar posterior lateral tooth, with a slight furrow forward to the pit and backwards nearly to the rostrum. Anteriorly, there is a long invalid lamina just within the border. The left valve has an anterior lamina, which forms, with its front dorsal margin, a shallow furrow to receive the lamina of the right valve. The post-dorsal margin of the left valve and its anterior lamina form a straight line, only interrupted by the notch of the cartilage pit.

The left valve lies inside the right valve throughout its post-dorsal border; the right valve lies inside the left, markedly along the posterior two-thirds of the ventral border, barely along its anterior third, and distinctly along the straight anterior end, where the right valve has a rather more concave edge than the left.

Dim.—Antero-posterior diam., 6·5 mm.; umbo-ventral, 4·1; section of united valves, 2·75.

Hab.—Off Cape Jaffa, in 300 fathoms, 3 alive and 12 valves; in 130 fathoms, 1 alive and 11 valves.

Diagnosis.—It is very closely allied to the *Cuspidaria perrostrata*, Dall, Bull. Mus. Comp. Zool., Harvard Coll., Cambridge, xii., 1885-1886, p. 296, pl. ii., figs. 3*a*, 3*b*, obtained in 339 fathoms, off Tortugas, and in 416 fathoms, gray ooze, near Grenada. Also in Bull., 37, United States National Mus., 1889, p. 66, pl. ii., figs. 3*a*, 3*b*. My species has a shorter rostrum, and the three bold ribs give it a distinct aspect. Dall says there is a good deal of variation in this group, and though my specimens vary scarcely at all, they may prove to be a variety of Dall's species. This shell contributes another new subgenus to the South Australian record, viz., *Cardiomya*.

Cuspidaria (Halonympha) ros, n. sp. Pl. xiii., figs. 1 to 4.

Shell small, inflated, pyriformly orbicular, very thin, diaphanous. Umbos visible, tumid directed somewhat backwards. Post-dorsal border a gentle incurved slope; anterior nearly continuous with the posterior for about two millimetres, then sweeping with an almost circular curve round the whole front and ventral border, to merge into the obliquely upward slope of the lower border of the rostrum, which is short, rather tapering, and round-ended.

Immediately beneath the minute approximate apex of each umbo is a projection carrying a tiny elongate cartilage pit. Some little distance behind this a wide-curved hollowed lamina, like half the bowl of a spoon, stands out in each valve.

There is a small elongate laminar cardinal tooth in front of the fossette of the right valve; none in the left.

The surface is smooth, but for microscopic concentric striæ, chiefly near the ventral margin.

Dim.—Antero-posterior diameter, 6 mm.; umbo-ventral, 4; sectional of closed valves, 2·5 mm.

Locality.—300 fathoms, off Cape Jaffa, 2 alive and 3 valves; 130 fathoms, 3 alive and 14 valves.

This new species introduces, for South Australia, a new subgenus, *Halonympha*, created by Dall and Smith, with *Neæra claviculata*, Dall, as the type (Bull. of Mus. of Comp. Zool., Harvard Coll., Cambridge, vol. xii., 1885-1886, p. 301). It is characterized by an acute cardinal tooth in the right valve, none in the left; a small central fossette, and by a clavicular rib or myophore in the posterior part of each valve.

Our shell is very closely allied to *Neæra claviculata*, Dall, Bull. Mus. Comp. Zool., 1881, vol. ix., p. 112, and *Halonympha claviculata*, Dall, Bull. Mus. Comp. Zool., Harvard

Coll., vol. xii., 1885-1886, p. 301, pl. ii., figs. 2 and 2*a*; also No. 425, p. 68, pl. ii., figs. 2 and 2*a*, in Bull. of the U.S. National Mus., xxxvii., 1889. *Type locality.*—North Atlantic, from 100 to 539 fathoms; also Chall. Zool., xiii., 1885, p. 52, pl. ix., figs. 8, 8*b*. *Locality.*—Bermudas, 425 fathoms, coral mud; here by the artist's mistake the clavicular process is omitted from the figure. But, judging from the illustrations and measurements given, our species differs in having a slightly longer rostrum, in being much smoother, and in its more spoon-shaped clavicle.

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EXPLANATION OF PLATES.

Plate XI.

Fig. 1. *Puncturella (Cranopsis) corolla*, Verco, ventral view.
,, 2. ,, ,, ,, ,, young specimen showing protoconch.
,, 3. ,, ,, ,, ,, dorsal view.
,, 4. ,, ,, ,, ,, sculpture.
,, 5. ,, ,, ,, profile.
,, 6. *Emarginula subtilitexta*, Verco, profile.
,, 7. ,, ,, ,, dorsal view.
,, 8. ,, ,, ,, sculpture.
,, 9. *Cuspidaria dorsirecta*, Verco, exterior.
,, 10. ,, ,, ,, interior.

Plate XII.

,, 1. *Arcoperna scapha*, Verco, prodissoconch.
,, 2. ,, ,, ,, profile, joined valves.
,, 3. ,, ,, ,, interior.
,, 4. ,, ,, ,, exterior.
,, 5. ,, ,, ,, shell tilted up, so as to show the deep groove for the reception of the ligament.
,, 6. *Cuspidaria exarata*, Verco, exterior.
,, 7. ,, ,, ,, interior.

Plate XIII.

,, 1. *Cuspidaria ros*, Verco, exterior, lateral.
,, 2. ,, ,, ,, ,, joined valves.
,, 3. ,, ,, ,, hinge.
,, 4. ,, ,, ,, ,,
,, 5. *Cuspidaria pinna*, Verco, exterior, lateral.
,, 6. ,, ,, ,, hinge.
,, 7. ,, ,, ,, ,,
,, 8. *Cuspidaria alta*, Verco, exterior, lateral.
,, 9. ,, ,, ,, hinge.
,, 10. ,, ,, ,, ,,
,, 11. ,, ,, ,, ,,
,, 12. *Modiola projecta*, Verco, interior, lateral.
,, 13. ,, ,, ,, exterior.
,, 14. *Modiolaria semiradiata*, Verco, exterior, lateral.
,, 15. ,, ,, ,, interior.

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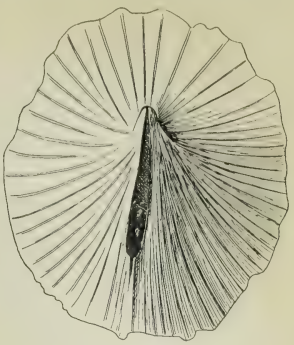

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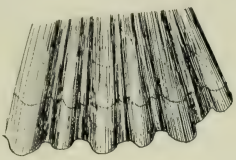

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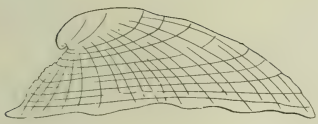

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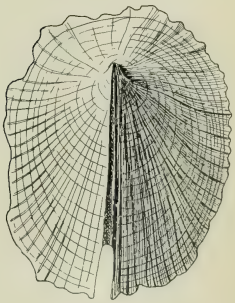

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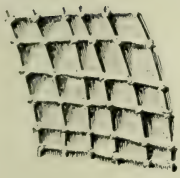

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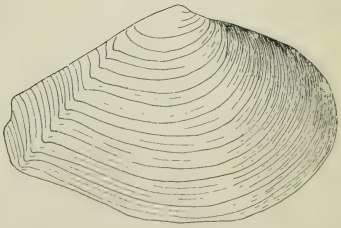

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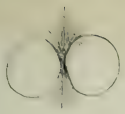
A. L. Kesteven del

Hussey & Gillingham, Printers, Adelaide.



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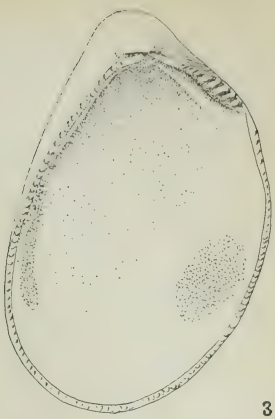

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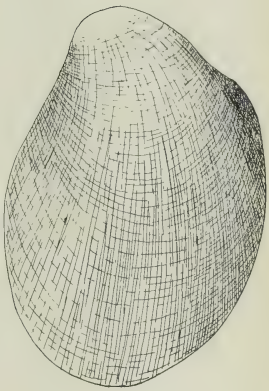

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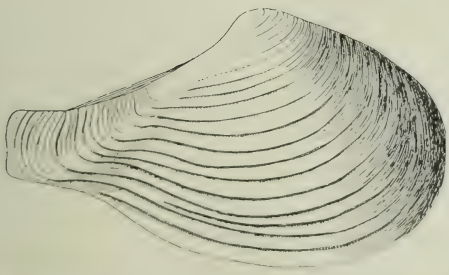

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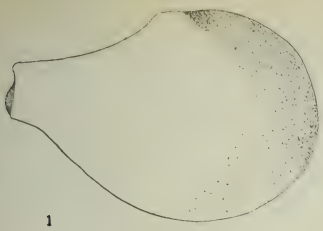

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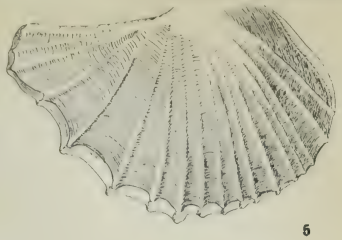

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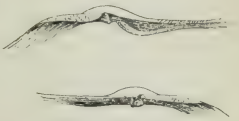

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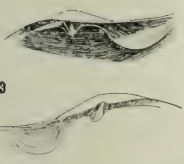

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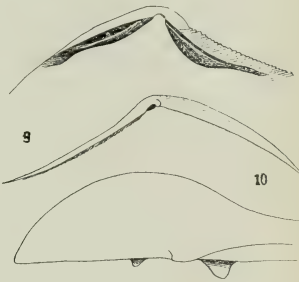

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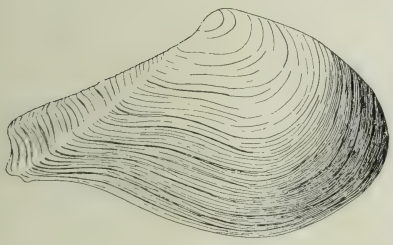

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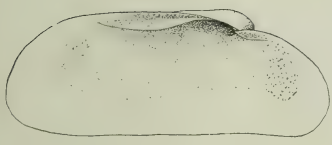

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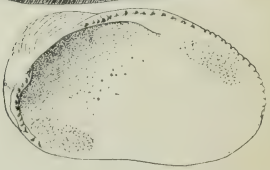

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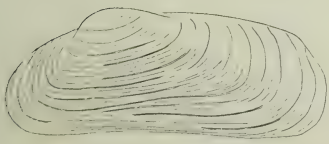

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Descriptions of Australian Curculionidæ, with Notes on Previously Described Species.

By Arthur M. Lea.

Part VI.

[Read August 4, 1908.]

SUBFAMILY LEPTOPSIDES.

Onesorus squamosus, n. sp.

Black, densely clothed with soft, pale-brown, round scales; interspersed with fine setæ.

Head with small dense concealed punctures; inter-ocular fovea minute. Eyes narrowly ovate, finely faceted. Rostrum stout, not much shorter than prothorax, rather strongly dilated at apex; with a strong central carina, but rest of sculpture hidden. Scape about half the length of funicle, the latter with first joint slightly longer than third, but distinctly shorter than second. *Prothorax* moderately transverse, sides strongly rounded, base and apex almost equal; ocular lobes strong and rounded; with large, deep punctures or foveæ occupying most of the surface. *Scutellum* distinct. *Elytra* very briefly ovate or subcordate, much wider than prothorax, sides strongly and regularly rounded; with regular rows of very large, partially concealed punctures; interstices regularly convex. *Legs* rather robust; tibiæ apparently not denticulate below. Length (excluding rostrum), 10½-11 mm.

Hab.—North-Western Australia: Onslow (C. French).

The scales are almost uniformly distributed, but are slightly paler on the under surface and legs than elsewhere; they are almost perfectly circular, very closely applied to derm, and have a peculiar velvety appearance. The setæ, especially on the elytra, are very fine and hair-like. The triangular apical plate is almost hidden by setæ, as in the description of *Obesus*, but that species (amongst other discrepancies) is said to have three sordid ochraceous vittæ on the prothorax.

Some specimens in the Macleay Museum have the clothing almost white.

Catastygnus densus, n. sp.

Reddish-brown or black. Densely and almost uniformly covered with scales of a very light-brown colour, but in places

with a slight golden gloss; elytra with paler markings and with dense setæ, usually slightly darker than the scales amongst which they are placed.

Rostrum tricarinate, carinæ normally concealed, but median one rather acute, the longitudinal depressions with rather coarse but concealed sculpture. *Prothorax* moderately transverse, sides moderately rounded, base not much wider than apex; with rather coarse partially concealed sculpture, but leaving a feeble median node exposed. *Elytra* considerably wider than prothorax, very feebly dilated to beyond the middle; with very large punctures in striæ, but appearing much smaller through clothing. Length (excluding rostrum), 11-13 mm.

Hab.—Queensland: Brisbane (R. Illidge and E. W. Ferguson).

The larger of the two specimens before me is (except as to its clothing) of an almost uniform reddish-brown, whilst the smaller one is black, but with parts of the appendages diluted with red. On each elytron of the larger specimen, just before the summit of its posterior declivity, there is a small patch of white scales, extending across two interstices, and vaguely connected with the shoulder by a stripe of scales slightly paler than most of those on the elytra; on the smaller specimen these markings can be just traced. They appear to be remnants of the V common to several species of the genus. The elytral setæ are not in two almost regular rows on each interstice (as in the description of *Rivulosus*), but are fairly dense, and although not in regular rows, generally three or four (sometimes more) can be traced at any one line between the interstices.

Catastygnus ochreipennis, n. sp.

Black, elytra and parts of legs obscurely diluted with red, scutellum dull red. Densely clothed with greyish or light-brown scales, thickly interspersed with fine setæ; but elytra with decided ochreous scales and setæ, except towards the sides, where the clothing is mostly black or sooty.

Rostrum tricarinate, the median carina acute and shining, the others less regular; sublateral sulci almost as deep as scrobes. *Prothorax* rather lightly transverse, sides moderately rounded; base distinctly wider than apex, granulate-punctate; with a distinctly impressed median line. *Scutellum* distinctly transverse. *Elytra* distinctly but not much wider than prothorax, sides feebly dilated to basal third; with large but partially concealed punctures in striæ. Length, 12½-15 mm.

Hab.—Queensland: Mackay (C. French).

The elytra are without trace of a V, but have dark sides, as in *scutellaris*, *textilis*, and others. The clothing is sparser on the upper surface of the head and rostrum than elsewhere. The femora are very feebly annulated.

Readily distinguished from all others of the genus by the conspicuous ochreous clothing of the elytra. The legs are stouter than in any other species of the genus known to me, and the prothorax is wider in proportion. The elytral clothing, except in its colour, is much as in *textilis*.

Catastygnus elegans, n. sp.

Black; parts of appendages obscurely diluted with red. Under surface with dense pale scales, having a more or less decided golden lustre; elytra with dense whitish scales, thickly interspersed with setæ, clothing of sides (except the extreme margins) blackish, the dark parts meeting at apex and running irregularly along suture to base; prothorax almost glabrous.

Rostrum with coarse partially concealed punctures; median carina very distinct, the others rather feeble. *Prothorax* moderately transverse, sides rather strongly rounded, base distinctly wider than apex, with coarse vermiculate sculpture, and with a rather feeble median line. *Elytra* much wider than prothorax, shoulders somewhat rounded, parallel sided to beyond the middle; punctures in striæ large and deep, but partially concealed. Length, 12½-14 mm.

Hab.—Queensland: Coen River (H. Hacker).

The elytra appear to have two wide stripes of white scales; the dark sutural marking is not quite so dark as on the sides. On one specimen almost the whole of the scales on the under surface are black, but this may be due to grease.

The elytral markings somewhat resemble those of certain specimens of *limbatus*, but the shoulders are square and the elytra are not dilated posteriorly. The prothorax is without the white lateral stripe nearly always present in members of the genus. In shape it is like *textilis*, and the elytral clothing (except about the suture) is much the same.

Amisallus tuberosus, Boh.

In the specific diagnosis of this species the antennæ are described as "subtenues," but in the generic diagnosis they are described as "validiusculæ," and the scape as "apice valde incrassato," with the two basal joints of the funicle elongate.

Four specimens before me (from Blue Mountains, Jenolan, and Forest Reefs) evidently belong to the species. They differ from *nodosus* in having the elytra flatter, with the

shoulders squarer, the tubercles more numerous and more obtuse—some of the basal ones on the inner interstice are almost obsolete, and the basal one does not overhang the prothorax. They also have a small but rather conspicuous tubercle on each side of the scutellum.

AMISALLUS WHITEI, Waterh.

Specimens of this species vary in length from 7½ to 12 mm. The species occurs in the coastal districts of E. Australia from the Clarence River, in New South Wales, to Mackay, in Queensland.

POLYPHRADES CONCINNUS, n. sp.

Blackish, appendages dull red. Very densely clothed with soft white or whitish scales, in places on the upper surface very feebly variegated with pale brown. With short dense setæ, not conspicuous on prothorax, but semierect on elytra, on which they form two or three rows on each interstice.

Head wide. Eyes briefly ovate, strongly convex, finely faceted. Rostrum slightly longer than wide, diminishing in width from base to apex; apical plate feeble, not triangular, and not sharply limited; inter-antennary space convex, rather narrow and almost parallel-sided. Scape thin, distinctly curved, passing eyes; first joint of funicle not much longer than second, second slightly longer than third, the others transverse; club moderately long. *Prothorax* moderately transverse, sides rather strongly rounded, base much wider than apex. *Elytra* somewhat ovate, base almost truncate and very closely applied to prothorax, widest at basal fifth, thence strongly diminishing in width to apex. Front *tibiæ* rather long, moderately curved, feebly denticulate. Length (excluding rostrum), 4-4½ mm.

Hab.—N.W. Australia: Roebuck Bay (C. French).

A pretty little species, with more prominent eyes than usual. In its very dense elytral setæ it resembles *setosus*, but the two species have little else in common. The scape when drawn back passes the front margin of the prothorax, a *Cherrus*-like character. On the head the scales mostly have a silvery gloss, but on the muzzle and under surface they mostly have a greenish or opalescent gloss.

On abrasion the head is seen to have small and not very dense punctures, and to be transversely impressed at its junction with rostrum. The rostral carina is very feeble. The prothorax has dense and rather coarse punctures, and is without granules. The punctures in the elytral striæ are large and not much narrower than the interstices; before abrasion, however, they appear to be much narrower.

POLYPHRADES EMBLEMATICUS, n. sp.

Black, appendages dull red. Densely clothed with soft scales, mostly muddy-brown on upper surface, and whitish (usually with a faint bluish gloss) on under surface. With dense and very stout but not conspicuous setæ.

Head wide. Eyes briefly ovate, rather coarsely faceted. Rostrum shorter than its width at base, sides decreasing in width from base to apex, apical plate small but with rather coarse punctures; inter-antennary space narrow, incurved, depressed, and apparently not carinated along middle. Antennæ stout; scape rather long, strongly curved, passing the eye; first joint of funicle not much longer than wide, distinctly longer than second, all the others transverse; club rather briefly ovate. *Prothorax* rather lightly transverse, sides strongly but not quite regularly rounded, base distinctly wider than apex, and both somewhat rounded. *Elytra* wider than usual, ovate-cordate, base conjointly rather strongly arcuate, distinctly wider than prothorax in both sexes, but especially in female. Front *tibiæ* comparatively short and stout, rather strongly denticulate. Length, $4\frac{1}{2}$-$5\frac{1}{2}$ mm.

Hab.—North-Western Australia (Macleay Museum).

In shape somewhat like *exoletus*, but setæ very different, the scape shorter, stouter, and more noticeably curved, the space between scrobes narrower, etc. The setæ are stouter even than in *setosus*, and are more depressed. The prothoracic punctures, however, readily distinguish it from all other species known to me.

The colour of the derm appears to be usually black or blackish, but in some specimens is of a dingy reddish-brown. The head has a very vague median line; on the prothorax two very faint discal lines can sometimes be traced, and on the elytra there are usually small irregularly distributed pale spots. The setæ (which are unusually stout) are (contrary to the normal fashion) more noticeable on the prothorax than on the elytra, and on the posterior declivity of the latter they are no more conspicuous than elsewhere.

On abrasion the head is seen to be closely covered with irregular longitudinal ridges, some of which are continued on to the rostrum. On the prothorax there are no granules, but the punctures are remarkable; they are of two kinds, large ones impressed each in the form of a crescent, the convex side of each directed towards a median line which has simple punctures only; between the arms of each crescent there is usually one small puncture; the rest of the surface has rather dense small punctures. On the elytra the punctures in the striæ are rather large, and the interstices are

moderately convex; before abrasion the punctures appear to be much smaller and the interstices scarcely separately convex.

POLYPHRADES LATUS, n. sp.

Black, antennæ and tarsi almost black. Densely clothed with brown, slightly mottled scales. With stout and rather dense setæ.

Head wide. Eyes ovate, coarsely faceted. Rostrum about as long as wide, almost parallel-sided, inter-antennary space somewhat cordate, decidedly lessened in width posteriorly; apical plate sharply defined and with distinct punctures, depressed, but not carinated along middle. Antennæ rather stout; scape rather strongly curved, distinctly passing eyes; first joint of funicle distinctly, but not much, longer than second, second slightly longer than third, fifth to seventh transverse; club moderately elongate. *Prothorax* almost as long as wide, sides strongly rounded, base not much wider than apex. *Elytra* wide, briefly subovate, base conjointly lightly arcuate and not margined, sides rather strongly rounded. Front *tibiæ* moderately long, rather lightly curved, moderately denticulate. Length, $6\frac{1}{2}$-$7\frac{1}{2}$ mm.

Hab.—Queensland: Cairns, Kuranda (H. Hacker).

An unusually wide species, with strongly curved scape and the eyes with coarser facets than usual. The rostrum, although wide, has the space between the scrobes rather narrow in front, and very narrow behind. The elytra are about as wide as in *laticollis*, but the prothorax is wider and more globose; the two species, however, have little in common. There is a vague resemblance to some dingy specimens of *æsalon*, but the rostrum is utterly different. On the under surface the scales are paler than on the upper, and usually have a faint golden gloss.

On abrasion the head is seen to be coarsely and rugosely sculptured, with small dense punctures on the raised portions; the rostrum is densely and rather coarsely punctate. The prothorax has dense granules, except close to apex, these being quite easily traceable before abrasion; the punctures are small and dense, with some larger ones scattered about, even on the granules. The punctures in the elytral striæ are rather large, and not much obscured by the clothing, but the dense and minute ones on the interstices are normally concealed.

POLYPHRADES PARVUS, n. sp.

Black, appendages dull red. Densely clothed with soft feebly variegated scales. With thin and rather sparse setæ, suberect only on posterior declivity.

Head wide. Eyes large, ovate, rather finely faceted. Rostrum slightly longer than wide, almost parallel-sided; inter-antennary space rather wide, parallel-sided; apical plate sharply defined and with distinct punctures, with, from its apex, a narrow but normally concealed carina extending backwards. Antennæ rather stout, scape rather lightly curved and passing eye; first joint of funicle as long as second and third combined, second distinctly longer than third, third to seventh transverse; club elongate-elliptic. *Prothorax* moderately transverse, sides strongly and regularly rounded, base and apex equal. *Elytra* somewhat ovate, conjointly lightly arcuate at base, at widest part distinctly wider than prothorax in female, not much wider in male. Front *tibiæ* moderately long, rather lightly denticulate. Length, $3\frac{3}{4}$-$4\frac{1}{4}$ mm.

Hab. — Queensland: Brisbane (A. J. Turner and H. Hacker).

A small and apparently somewhat variable species as regards its clothing. In general appearance it is very close to *inconspicuus*, but the scape is slightly curved (in *inconspicuus* it is quite straight). The pattern of the markings (obscure in both species) is not quite the same, but before abrasion the only valid distinction that I can find is in the scape. On abrasion, however, the prothorax in *inconspicuus* is seen to be covered with flattened densely punctate granules, some of which are connected together, and with spaces between causing a somewhat vermiculate appearance. In the present species the granules are smaller, more rounded, all (or at least where I have abraded the surface) isolated, and with sparser punctures. On the upper surface the scales are of a pale dingy brown, faintly variegated with grey, the grey forming feeble rings around the eyes, a feeble line on forehead, a very feeble stripe (distinct only towards the base) on each side of middle of prothorax, and a feeble line from each shoulder to near the middle, when it is obliquely directed towards (but not to) the suture, elytra elsewhere with very feeble spots. On the under surface and sides the scales are mostly greyish white, sometimes with a faint silvery or golden gloss.

On abrasion the head is seen to be feebly subgranulate and with small but distinct punctures, the rostrum has distinct punctures, and there is a transverse impression at its base. The prothorax has numerous granules, except at apex, but they are greatly obscured by clothing; the punctures in the elytral striæ are rather large, but normally appear to be very small.

POLYPHRADES GRANICOLLIS, n. sp.

Black, antennæ and tibiæ dull red. Densely clothed with blackish-brown scales, more or less variegated on upper surface; under surface mostly with greyish-green scales. With thin and rather numerous setæ, suberect only on posterior declivity of elytra.

Head very wide. Eyes ovate, coarsely faceted. Rostrum about as long as wide, almost parallel-sided; inter-antennary space rather wide, parallel-sided; apical plate large, sharply defined, and with distinct punctures, a narrow but acute carina proceeding backwards from its apex. Antennæ not very stout; scape lightly curved, passing eye; first joint of funicle the length of second and third combined, second distinctly longer than third, the others rather feebly transverse; club elongate-elliptic. *Prothorax* rather lightly transverse, sides rather strongly rounded, base slightly wider than apex, the latter slightly sinuous. *Elytra* ovate, base conjointly arcuate and closely applied to prothorax, wider than prothorax in both sexes and widest just before middle. Front *tibiæ* moderately long, lightly curved, moderately denticulate. Length, 4½-6 mm.

Hab.—South Australia: Mount Lofty (A. M. Lea).

The eyes are more coarsely faceted than usual, and the species at a glance appears to belong to *Essolithna* (its resemblance to *echimys* is quite striking), but the claws are not single. The prothoracic granules are much more conspicuous before abrasion than usual. Although not a striking species it does not seem close to any other before me. One specimen has the tibiæ and femora pale as well as the tarsi. On the head the pale scales form three distinct but irregular lines, on the prothorax they form two very irregular lines on each side, and on the elytra they form numerous small spots about the punctures.

On abrasion the head is seen to be feebly subgranulate, and to have small punctures, the latter becoming denser and more distinct on the rostrum. The prothorax (except at its apex) is closely covered with round flattened granules (these being traceable before abrasion) and with dense small punctures interspersed (even on the granules) with a few slightly larger ones. The punctures in the elytral striæ are rather large, and normally not much concealed.

POLYPHRADES CORDIPENNIS, n. sp.

Black. Densely clothed with pale golden-brown scales, becoming bluish-white (in places with golden gleams) on under surface and sides. With dense, moderately stout,

more or less erect setæ, more noticeable on elytra than on prothorax. Club with black sensitized pubescence.

Head moderately wide. Eyes large, ovate, finely faceted. Rostrum distinctly, but not much, longer than wide, sides very feebly increasing in width almost to apex; inter-antennary space fairly wide, parallel-sided, widely depressed and apparently feebly carinated along middle; apical plate sharply defined, curvilinearly triangular, with dense punctures. Antennæ rather stout; scape almost straight, just passing eye; first joint of funicle as long as the two following combined, second distinctly longer than third, the others rather feebly transverse; club elongate-ovate, with black sensitized pubescence. *Prothorax* lightly transverse, sides strongly and regularly rounded, base, if anything, slightly narrower than apex, the latter slightly sinuous. *Elytra* cordate, widest (and considerably wider than prothorax) near base, thence strongly diminishing in width to apex. Front *tibiæ* rather long, feebly curved, denticulate, but with a strong apical spur. Length, 7½ mm.

Hab.--Queensland: between Charters Towers and Cloncurry (H. Hacker).

The elytra are quite remarkably heart-shaped; even more so than in *tumidulus*. Compared with that species it differs in the elytra having longer and more erect setæ, the prothorax more globose, the rostrum with normal triangular plate, the space between the scrobes narrower and differently shaped, eyes less coarsely faceted, etc. The scape when extended forwards appears to be too short to reach the hind margin of the eye, but when drawn backwards just passes it. The spur at the apex of the tibiæ is very conspicuous, and is not at all concealed by clothing.

Where I have abraded the head of the unique specimen before me it is seen to be covered with small granules and small dense punctures, but I have not abraded much of it, nor any portion of the rostrum. The prothorax has dense granules (a few of which are traceable before abrasion) and numerous small punctures. The punctures in the elytral striæ are large, but normally greatly obscured by the clothing.

SUBFAMILY GONIPTERIDES.

Oxyops frenchi, n. sp.

Black; muzzle, antennæ, and parts of legs obscurely diluted with red. Rather densely clothed with short stout setose whitish scales, becoming setæ on antennæ and parts of legs.

Head with small, dense, and usually concealed punctures; inter-ocular fovea small, narrow, and deep. Rostrum about once and one half as long as greatest width; with a fine median carina, on each side of which is a shallow groove, but, except at apex, where the carina and grooves are absent, sculpture more or less concealed. First joint of funicle almost as long as second. *Prothorax* with coarse irregular punctures; disc somewhat flattened; with a feeble median carina on apical half. *Elytra* wide; with rows of large deep punctures, becoming somewhat smaller posteriorly; with granules rather densely scattered about; second interstice with a tubercle at summit of posterior declivity, third with the largest of all near base, fourth with one near that on second, preapical callus conical and distinct, shoulder with a large tubercle. Intercoxal process of *mesosternum* strongly produced, but obtuse. *Tibiæ* apparently not denticulate. Length (excluding rostrum), 10 mm.

Hab.—Queensland: Somerset (C. French).

On the prothorax the scales are rather stouter than elsewhere, and are interrupted by four feeble irregular longitudinal lines, which, under a lens, appear to be granules formed by the irregularity of the punctures. To the naked eye each elytron appears to have a row of tubercles commencing near the suture and directed towards the side at the basal fourth; but only two of these tubercles (the ones on the second and fourth interstices) are at all distinct, the apparent presence of tubercles on the sixth, eighth, and ninth being caused by rather numerous nude granules; the sixth, however, is really slightly elevated.

At a glance not unlike large specimens of *vitiosa*, but the third interstice with one tubercle only instead of three. The type (except as to its clothing) is almost entirely black; but a second specimen (perhaps owing to immaturity) is almost entirely of a dull red.

Oxyops scabra, n. sp.

Black; antennæ almost black. Irregularly clothed with whitish scales and setæ.

Head with dense and minute punctures; inter-ocular fovea rather small, narrow, and deep. Rostrum about once and one half as long as greatest width; with a smooth minutely punctate median line, on each side of which are several irregular rows of large partially concealed punctures; apex with small punctures interspersed with some of moderate size. *Prothorax* with coarse irregular punctures, causing an appearance in places as of irregular granules; with a strong but irregular median carina. *Elytra* much wider than usual;

with rows of very large irregular punctures, many of which are separated from each other only by a large shining granule; third interstice with a large and coarsely granulated tubercle near base, and a large subconical one at summit of posterior declivity; shoulder tuberculate and laterally produced; preapical callus granulate but not very conspicuous; fifth interstice elevated and granulate, but scarcely tuberculate beyond the middle; elsewhere with numerous shining granules, some of which (especially about the middle of the disc of each, and on the basal third near the suture) are of considerable size. Intercoxal process of *mesosternum* moderately acute. *Tibiæ* feebly denticulate. Length, 12 mm.

Hab.—Queensland (C. French).

The median line of the rostrum could scarcely be regarded as a carina. The type is probably partly abraded, but represents such a distinct species that I have not hesitated to describe it. Between the two large tubercles crowning the posterior declivity there is a very distinct and subtriangular patch of scales, but this may be due simply to the tubercles protecting it from abrasion. At a glance it looks somewhat like a large rough specimen of the preceding species, but the rostrum is smoother, and the third interstice has two tubercles.

OXYOPS MUCRONATA, n. sp.

Black, antennæ and tarsi obscurely diluted with red. Rather densely clothed with long thin whitish setæ, shorter and sparser (but still moderately dense) on elytra than elsewhere.

Head with rather large but normally almost concealed punctures; inter-ocular fovea unusually small. Rostrum (excluding the glabrous apical portion) subquadrate; with a conspicuous median carina, on each side of which is a distinct and rather wide groove. *Prothorax* with dense and partially concealed punctures of moderate size; with a strong but irregular median carina in the middle of a wide and rather shallow depression. *Elytra* wide, rather strongly narrowed from near base to apex; apex strongly mucronate; with rows of large rugose punctures, becoming smaller posteriorly; each with three large tubercles, one on the fourth interstice near base, one on the third about middle, and the preapical callus; with numerous flattened granules scattered about. Intercoxal process of *mesosternum* strongly produced and acute. *Tibiæ* apparently not denticulate. Length, 11-12 mm.

Hab.—Queensland: Bowen (Aug. Simson).

The elytra are much more strongly mucronate than in any other species known to me. The large basal tubercle situated on the fourth interstice instead of on the third is unusual.

At first sight apparently belonging to *Gonipterus*, but the intercoxal process of mesosternum is quite strongly produced. In most species of *Oxyops* the eyes are strongly convex, and the head appears to be suddenly constricted behind them, so as to give them an appearance as of projecting; but in the present species the eyes, although moderately convex, appear to be quite regularly embedded (as in the species of *Pantoreites*). When alive specimens are probably covered with an ochreous meal, as on one specimen this meal is caked in places.

OXYOPS GRIFFITHI, n. sp.

Black or piceous black, antennæ and tarsi obscurely diluted with red. Moderately, in places densely, clothed with whitish setæ, varying from thin to thick, and in places appearing as elongate scales, and forming a distinct postmedian fascia.

Head with dense, more or less concealed punctures; interocular fovea large, rather wide and deep. Rostrum about once and one third as long as greatest width; with a rather feeble, shining, and feebly punctured median line, on each side of which are coarse irregular rows of partially concealed punctures. Two apical joints of funicle somewhat transverse. *Prothorax* with coarse irregular punctures, causing an appearance as of granules in places; with a rather fine median carina, on each side of which the surface is somewhat flattened, and the punctures less irregular than elsewhere. *Elytra* with rows of very large punctures, becoming smaller posteriorly; third interstice with two tubercles, a large one near base, and a smaller somewhat elongate one at summit of posterior declivity; fifth elevated but scarcely tuberculate beyond the middle, shoulder tuberculate, preapical callus large but obtuse; with numerous granules scattered about and dense on tubercles. Intercoxal process of *mesosternum* not very acute. *Tibiæ* feebly denticulate. Length, 9-9½ mm.

Hab. — Queensland: Townsville (H. H. D. Griffith), Upper Endeavour River (C. French).

The postmedian fascia occupies the upper half of the posterior declivity, and is directed obliquely forwards so as to touch, or almost touch, the margins. One of the three specimens before me (except as to its clothing) is almost entirely of a dull red, but this may be due to immaturity.

With a vague resemblance to *fasciata*, but fascia not narrowed to suture, and the third interstice abruptly tuberculate at summit of posterior declivity. From *vitiosa* it differs in the third interstice having two tubercles only.

Oxyops decipiens, n. sp.

Black; antennæ and tarsi obscurely diluted with red. Rather densely clothed with thin setæ, becoming much shorter on elytra.

Head with dense and small more or less concealed punctures; inter-ocular fovea rather narrow. Rostrum about once and one third as long as greatest width; with dense and coarse punctures; with two feeble shallow grooves, between which is a very feeble carina or punctured line. Antennæ unusually short; first joint of funicle slightly longer than second, second feebly, all the others strongly, transverse. *Prothorax* with coarse irregular punctures, in places becoming foveate and in places small; with a feeble and interrupted median carina. *Elytra* wide at base, strongly narrowed from shoulders to apex; with rows of large punctures, becoming very large and deep on an oblique space from near shoulders to suture at basal third; each with three tubercles near base, one on third interstice, one on shoulder, and a strongly conical one between shoulder and side; preapical callus obtuse. Intercoxal process of *mesosternum* distinctly produced, but obtuse. *Tibiæ* strongly denticulate. Length, 8½-9½ mm.

Hab.—Queensland (C. French).

On the elytra the clothing is very dense and short, except for a wide oblique irregular seminude stripe where the punctures are coarsest. To the naked eye the preapical callosities appear to be feebly fasciculate and surrounded by a slightly darker space than the surface just outside of this space. The elytra also to the naked eye appear to have a wide oblique and rather feeble postmedian fascia. The granules of the under surface are rather more conspicuous, and the parts of the metasternum overhanging the hind tibiæ are much more produced than usual.

At a glance quite a typical *Gonipterus*, but the mesosternum produced, and the subhumeral tubercles placed in a line with the others near the base, instead of behind them, as in *Gonipterus*. The eyes are more convex, but otherwise much as in *mucronata*.

Oxyops rufa, n. sp.

Of a rather bright flavous-red, rostrum darker; head and claws black. Rather densely clothed with whitish setæ, except on prothorax and elytra, where they are sparser.

Head with very dense but almost concealed punctures; inter-ocular fovea rather small and narrow. Rostrum about once and two thirds as long as greatest width; apical portion with small punctures and smoother than usual, else-

where with dense and coarse punctures; with a narrow but sometimes partially concealed median carina. *Prothorax* granulate-punctate; sides more evenly rounded than usual; disc somewhat flattened and scarcely carinate. *Elytra* almost parallel-sided from shoulders to beyond the middle; with regular rows of large round punctures, becoming smaller posteriorly; with numerous small and more or less depressed granules. Intercoxal process of *mesosternum* strongly produced but obtuse. *Tibiæ* moderately denticulate. Length, 6½-9 mm.

Hab.—Victoria (C. French); New South Wales: Jenolan (J. C. Wiburd).

The sides of the prothorax, and some of the punctures on the elytra are sometimes stained with black or brown, and on the elytra this causes a feeble mottling, or an appearance as of feeble interrupted fasciæ. On the prothorax the setæ are condensed so as to form a moderately distinct median line, and feeble lateral ones. On the elytra they appear, to the naked eye, to form very feeble transverse patches, but on one specimen there is a distinct postmedian fascia, which might quite fairly be regarded as formed by scales. On both prothorax and elytra there are black setæ scattered about amongst the others.

In some respects close to description of *rutila*, but head darker than rest of body and elytra smooth.

Oxyops pallida, n. sp.

Pale flavous-red, antennæ somewhat darker, claws and parts of muzzle black. Densely (very densely on parts of the under surface) clothed with white setæ, shorter and somewhat sparser on the elytra than elsewhere.

Head with regular but partially concealed punctures; inter-ocular fovea (for the genus) very small. Rostrum (excluding the muzzle) about as long as greatest width (which is at the base instead of near the apex); without a median carina or line, and with rather small and even, partially concealed punctures. *Prothorax* less transverse than usual, sides evenly rounded; densely granulate-punctate; with a distinct, but irregular, median carina. *Elytra* evenly convex, sides feebly diminishing in width from shoulders to near apex; with regular rows of round, and (for the genus) rather small punctures, becoming smaller posteriorly; with numerous small depressed granules. Intercoxal process of *mesosternum* acute. *Tibiæ* feebly denticulate. Length, 9½ mm.

Hab.—North-Western Australia: Ashburton River (C. French).

Entirely pale except for the combs of tibiæ and the claws, which are deep black; the combs are unusually conspicuous, owing to the colour of the tibiæ and tarsi, but they are of quite normal size. The specimen described is apparently not immature, as Mr. French has another specimen of exactly the same colour. The eyes are almost exactly as in *mucronata*. The joints of the funicle are of normal proportions, but are rather more cylindrical than usual.

Oxyops parallela, Blackb.

The length given in the description of this species is 2 lines, but Mr. Blackburn informed me that 2 was a misprint for 4. A specimen from Port Darwin before me is but $3\frac{1}{2}$ lines.

Oxyops uniformis, Lea.

A specimen from the Grampians (Victoria) of this species has a moderately distinct transverse fascia of pale clothing before the middle, and an irregular stripe one-third from the apex of the elytra. On the type these markings can be just perceptibly traced.

Pantoreites major, n. sp.

Black or blackish-brown; elytra, tip of prothorax, and appendages (except claws) more or less reddish. Clothed with thin whitish or ochreous setæ, and with glistening white scales.

Head with dense partially concealed punctures; interocular fovea narrow and partially concealed. Rostrum slightly dilated towards, but not to, apex, almost twice as long as greatest width; with dense punctures throughout, but smaller and exposed towards apex, and more or less concealed towards base. Two basal joints of funicle subequal in length, but first somewhat stouter than second. *Prothorax* with very dense punctures of moderate size. *Elytra* with regular rows of rather large punctures, but which are quite concealed in places, shoulders strongly rounded, sides feebly diminishing in width to beyond the middle, and then strongly to apex. Intercoxal process of *mesosternum* obtusely produced. *Tibiæ* strongly denticulate. Length, 7-$8\frac{1}{2}$ mm.

Hab.—South Australia: Murray Bridge (H. H. D. Griffith); Victoria (C. French), Sea Lake (J. C. Goudie).

The setæ are rather sparse, but the snowy scales (which from some directions are faintly opalescent) are very dense except on head and base of rostrum, where, however, they form a moderately distinct line. On the prothorax they form three lines, which gradually dilate to the base. On the

elytra the suture is clothed throughout, the second interstice becomes clothed beyond the middle, and the third about one-third from the apex; the fifth interstice is clothed from the basal fifth, and the white stripe is dilated posteriorly so as to cover the fourth and sixth as well; the three lateral interstices are clothed throughout. The under surface and legs are also densely clothed with white scales.

In appearance somewhat close to *vittatus*, but larger (it is the largest of the genus yet known), and silvery clothing covering a much greater portion of elytra and somewhat differently disposed. One of the specimens (except as to its clothing) is almost entirely of a dull red.

PANTOREITES TRILINEALBUS, n. sp.

Head, rostrum, and prothorax reddish-brown; elsewhere paler, but claws black. Densely clothed with white glistening scales, but in places more or less setose, and with an ochreous meal.

Head with very dense but concealed punctures; interocular fovea of moderate size, but partially concealed. Rostrum subparallel-sided, about once and two thirds as long as greatest width; apical half nude, and with small punctures, basal half with much coarser but partially concealed ones. First joint of funicle stouter but distinctly shorter than second. *Prothorax* scarcely, if at all, wider than long, base and apex subequal in width; with dense but more or less concealed punctures. *Elytra* considerably wider than prothorax, shoulders rounded, almost parallel-sided to near apex; with rows of rather large but usually concealed punctures. Intercoxal process of *mesosternum* scarcely produced. *Tibiæ* curved and moderately denticulate. Length, $4\frac{3}{4}$ mm.

Hab.—New South Wales: Gosford (A. M. Lea).

The derm and punctures are almost entirely concealed by clothing. The clothing of the under surface is entirely white, except that from certain directions it appears to be slightly opalescent. On the upper surface the setæ or thin scales, which are mixed with an ochreous kind of dust or meal, form a stripe on each side of the middle from apex of prothorax almost to apex of elytra, and a more feeble stripe on each side for the same length. In consequence the prothorax appears to have three conspicuous white stripes, each of which is dilated towards the base; and the elytra to have three stripes, of which the sutural one is the narrowest and most conspicuous. The sublateral white stripes have several small nude spots about their middle, and these are probably not accidental, as they are much the same in the two specimens before me. It is probable that after immersion in

some fluids the darker stripes (especially on the elytra) would lose their ochreous meal and become less conspicuous.

In appearance somewhat like *micans*, but outline of elytra not almost continuous with that of prothorax, and the clothing more conspicuously bicolorous. In shape it is much like *illuminatus* and *vittatus*.

IPTERGONUS, n. g.

Eyes strongly convex and projecting, owing to constriction of head immediately behind them. Elytra without subhumeral tubercles. Intercoxal process of mesosternum rounded. Body very short and compact. Other characters as in *Oxyops* and *Gonipterus*.

This genus is proposed to receive a number of small and very robust species, which differ from *Gonipterus* in the absence of subhumeral tubercles, and from *Oxyops* in the simple mesosternum. The type of the genus is *Gonipterus cionoides*, Pasc.; but I also refer to it *Oxyops aberrans*, Lea. To judge from the description *Oxyops hyperoides*, Pasc., belongs to it, and *Oxyops turbidus*, Pasc., may also do so.

The Australian genera of *Gonipterides* may be tabulated as follows:—

Tarsi three jointed ... ... *Syarbis.*
Tarsi four jointed
  Club continuous with funicle ... ... *Bryachus.*
  Club not continuous with funicle.
    Eyes not prominent... ... ... *Pantoreites.*
    Eyes very prominent.(1)
      With a distinct tubercle on each side near base of elytra (2) ... ... *Gonipterus.*
      Without such a tubercle.(3)
        Intercoxal process of mesosternum produced ... ... *Oxyops.*
        Intercoxal process not produced. *Iptergonus.*

IPTERGONUS BIFURCATUS, n. sp.

Reddish-castaneous, under surface darker in parts; claws black. With snowy-white scales on head, forming three lines on prothorax, and lines at sides of elytra, dense on scutellum and parts of under surface and legs; elytra with several fascicles of white or ochreous scales. Rest of surface with scattered setæ or scales.

(1) In several species of *Oxyops* the eyes are but little more prominent than in *Pantoreites*, but the two genera are otherwise very distinct.

(2) Not on the shoulder, which, however, is often more or less tuberculate.

(3) In *Oxyops*, a tubercle is sometimes present near the base, but these species differ from *Gonipterus* in having the mesosternum produced.

Head with quite concealed punctures; inter-ocular fovea more or less concealed. Rostrum about once and one third as long as greatest width; non-carinate; apical portion strongly convex and with dense and rather small punctures; basal two-thirds with coarse but more or less concealed punctures. First joint of funicle slightly longer than third, but distinctly shorter than second. *Prothorax* with dense punctures of almost even size; sides rather strongly diminishing in width from base to apex. *Elytra* briefly subcordate, much wider than prothorax; shoulders very feebly produced; with rows of deep, more or less oblong punctures; with small dense granules, and with feeble tubercles. *Tibiæ* strongly denticulate. Length, $4\frac{1}{2}$-5 mm.

Hab.—Queensland (Horace W. Brown), Blackall Range (H. Hacker).

The white stripe on each side of the prothorax is continued on to the elytra. On perfectly fresh specimens it clothes the shoulders, but these are usually abraded; on the sixth interstice it terminates at the middle, but the eighth and ninth are clothed almost to the apex, and the tenth is clothed near the base and again near the apex. On each elytron there are five feeble tubercles crowned with feeble fascicles (white on two specimens, ochreous on two others, and all apparently easily abraded); of these there are three on the third interstice, the basal one being elongate and very feeble, and the hind one on summit of posterior declivity. On the fifth interstice there are two, of which one is post-median, and the other is the preapical callus. When completely abraded some of the tubercles appear to be little more than feebly elevated spaces, with rather more numerous granules than usual.

Readily distinguished from *aberrans* by the stripe on each side of prothorax bifurcating on to elytra, instead of stopping at the base.

Iptergonus niveopictus, n. sp.

Reddish-brown, appendages somewhat paler; claws black. With snowy-white scales on head, forming three lines on prothorax, lines and fascicles on elytra, and dense on scutellum parts of under surface and legs; elsewhere with sparse ochreous or white setæ or scales.

Head, rostrum, antennæ, and *prothorax* much as in preceding species. *Elytra* much less parallel-sided, and with much coarser punctures, interstices narrower and with less numerous granules; tubercles apparently much the same. Front *tibiæ* rather strongly curved and all strongly denticulate. Length, $4\frac{1}{3}$ mm.

Hab.—New South Wales: Sydney (A. M. Lea).

The only specimen before me is evidently in perfect condition. On the elytra the snowy scales clothe the suture and parts of the sides, and form three oblique stripes on each, with each stripe ending in a fascicle; one commences near the shoulder and terminates before the middle, one commences a short distance behind the first and terminates beyond the middle, and the third terminates on the preapical callus. Of the fascicles (which are of such a nature that they may be easily abraded) there are three on the third interstice and three on the fifth, with several feeble ones elsewhere.

In some respects close to description of *hyperoides* (described as from Queensland), but smaller (two instead of two and a half lines), and with conspicuous elytral fascicles.

SUBFAMILY BELIDES.

Belus cristatus, n. sp.

Piceous-brown, antennæ and claws somewhat paler. Clothed with white pubescence, margining eyes, forming three feeble lines on prothorax, forming numerous small spots in the subsutural depression (especially towards the base) and three feeble rows of small spots elsewhere on each elytron, and rather dense on under surface.

Head with dense clearly defined punctures, becoming rather coarse between eyes. Rostrum slightly shorter than head and prothorax combined, feebly inflated at insertion of antennæ, the sides very feebly incurved between these and apex; behind antennæ with rather coarse but partially concealed punctures, between antennæ with fairly large punctures but becoming very small to apex. Antennæ thin, first and third joints subequal, eleventh shorter than ninth and tenth combined. *Prothorax* strongly inflated towards base, with a wide but slightly interrupted median channel, the sides of which are rather more strongly elevated than usual; with dense but irregular granules and punctures. *Scutellum* moderately transverse. *Elytra* shallowly depressed on each side of suture, each depression bounded by a distant carina, which gradually runs out towards the base, but is rather suddenly terminated towards the apex, a feeble carina outside the first one and about half its length, each separately strongly rounded and granulate at base; apex acutely produced and passing abdomen for a greater length than its apical segment; with dense and rather coarse punctures, and with rather numerous granules at base. *Metasternum* with a few small granules. *Femora* edentate, posterior passing middle of second abdominal segment; front tibiæ moderately, the others feebly denticulate below. Length, 12 mm.

Hab.—South Australia: Port Lincoln (Macleay Museum).

The type is probably a male; on its metasternum there are two nude spots on each side piece and numerous smaller and irregular nude spots (mostly caused by granules) elsewhere. The abdomen is densely clothed at the sides, and with a nude spot on each side of each segment, but these nude spots open into the nude median portion, instead of being isolated.

From *bison* (which at a glance it strongly resembles) it is distinguished by the elytral carinæ, and these being two on each elytron (instead of three) distinguish it from the description of *perplexus*. From *semipunctatus* (which also in shape it strongly resembles) it is distinguished by its edentate femora.

BELUS VARIPILIS, n. sp.

Black; part of antennæ and the claws obscurely diluted with red. Clothed with stramineous (on the elytra becoming ochreous) pubescence at the sides of the eyes, forming three lines on prothorax (the median line interrupted in middle), dense on scutellum, and forming numerous more or less feeble spots in feeble rows on elytra. Under surface with a dense line on each side from the eye to apex of abdomen, but with two nude spots on side piece of metasternum.

Head with dense and irregular punctures, becoming coarse between eyes. Rostrum thin; in female the length of head and prothorax combined, in male somewhat shorter; with fine punctures almost throughout in female, but becoming rather dense and coarse behind antennæ in male. Antennæ (for the genus) not very thin, first joint as long as second and third combined, eleventh stout and about the length of ninth and tenth combined. *Prothorax* strongly inflated towards base, with a wide but interrupted median channel; with dense clearly defined and mostly rather large punctures. *Scutellum* moderately transverse. *Elytra* depressed on each side of suture, the depression bounded on each side by a strong carina, outside of this on each elytron a shorter and finer carina, then a feeble depression and then a feebly raised line or very feeble carina; base strongly separately rounded; apex acutely produced and passing abdomen fully the length of its apical segment; with dense and fairly large punctures. *Femora* edentate, front pair stout, especially in female, hind pair not extending to middle of second abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 13-15 mm.

Hab.—Queensland: Somerset (C. French), Endeavour River (Macleay Museum).

The spots are numerous in the subsutural depression and form three rows (of which only the median one is at all distinct) elsewhere on each elytron. The metasternum is glabrous in the middle, but not towards the sides. On both specimens before me the pubescence on each side of the basal segment of abdomen is suddenly interrupted, so that at its apex it is glabrous, the three following segments have each a similar but much smaller glabrous space, and these three have as well a small spot of pubescence which is sometimes joined to the lateral stripe. On one of the specimens the pubescence is of an almost snowy whiteness. There are no distinct granules on either prothorax or elytra, although about the base of the latter the punctures are so irregular as to cause (from some directions) the apparent presence of a few. The elytra are not suddenly elevated behind the scutellum.

In general appearance close to *semipunctatus*, but wider, femora edentate, and tibiæ and tarsi dark. Also very close to the preceding species, but basal joint of antennæ considerably longer, the two carinæ on each elytron much stronger, with traces of a third and the clothing of abdomen different. It is also rather more robust, with the prothorax much less elevated on each side of the median channel. *Perplexus* is described as having "three well-defined carinæ on each of its elytra"; in the present species two carinæ are distinct, but the outer one, if indeed it should be regarded as a carina at all, is very indistinct; the inner one commences quite close to the base, very much nearer, in fact, than "at a distance from the base about equal to a quarter of the length of the elytra"; the prothorax also is not "ruguloso-granuloso."

Belus pulverulentus, n. sp.

Black, antennæ and claws feebly diluted with red. Clothed with white pubescence, margining eyes, forming an interrupted median line on prothorax, and feeble lateral lines; forming numerous feeble spots about suture (these more or less tinged with ochreous), and two very feeble rows on each elytron elsewhere; and rather dense, but irregularly distributed, on under surface.

Head with dense and rather coarse punctures; scarcely transversely impressed behind eyes. Rostrum slightly longer than prothorax; with dense and fine punctures at apex, becoming slightly sparser and larger to antennæ, but thence more rapidly so till on the base itself they are coarse. Antennæ thin, moderately long, first joint distinctly longer than second and third combined, eleventh the length of ninth and tenth combined. *Prothorax* rather strongly inflated towards base, with a wide but interrupted median channel,

closely covered with rounded and usually flattened granules. *Scutellum* moderately transverse. *Elytra* feebly depressed on each side of suture, the depression bounded by a slight elevation but not by a carina, base suddenly raised and granulate behind scutellum; each separately strongly (somewhat angularly) rounded and granulate at base; apex produced and passing abdomen for rather more than the length of its apical segment, with rather dense punctures, becoming towards base interspersed with round granules, interspaces between punctures and granules with very small punctures. *Metasternum* with a few rather conspicuous granules. Front *femora* stout, with two minute teeth placed transversely near apex, the others edentate, posterior extending almost to middle of second abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 17½ mm.

Hab.—Queensland: Gayndah (Australian Museum), Chillagoe (J. A. Anderson).

On the under surface the clothing is dense (except for a nude spot on each side piece of the metasternum), on the sides of sterna and fairly dense in their middle, and forms a rather large but loose spot on each side of each of the abdominal segments, also a fairly large spot on the middle of the first segment; the second and third have a feeble white line along the middle, and there are minute scattered spots elsewhere. The elytral granules from all directions are distinct only near the base, but from some directions they appear to extend almost to the apex. In addition to the subsutural depression each elytron has a feeble longitudinal depression about its middle. One specimen differs from the type in being (except the head and rostrum, which are black) of a deep reddish-brown, with pale antennæ, tibiæ, and tarsi. Its abdomen is apparently partly abraded, as, except for the clothing on the sides and middle, it is practically glabrous.

Moderately close to *semipunctatus*, but elytra noncarinate and with a hump about scutellum; the hump is much more prominent than in *puncticeps*, and the basal joint of its antennæ considerably longer. *Anguineus*, to which it is also very close in appearance, has edentate femora.

Belus niveopilosus, n. sp.

Blackish-brown, antennæ and claws of a dingy red. Clothed with white pubescence, margining eyes (rather sparse elsewhere on head), forming a distinct median and feeble lateral lines on prothorax, rather dense on scutellum, forming three rows of spots on each elytron, and dense but irregularly distributed on under surface.

Head with dense and coarse but partially concealed punctures. Rostrum (for the genus) rather stout, the length of prothorax, feebly inflated at insertion of antennæ, behind which the punctures are rather coarse and in front of which they are fine, especially towards the apex. Antennæ not very thin, first joint slightly longer than third, second and third equal in length, eleventh slightly shorter than ninth and tenth combined. *Prothorax* rather strongly inflated towards base, median channel rather feeble, with dense granules and punctures throughout. Scutellum rather strongly transverse. Elytra flattened but scarcely depressed along suture, not suddenly raised behind scutellum; each separately strongly rounded at base, apex somewhat acutely produced and passing abdomen for about the length of its apical segment; punctures and granules, except that they are smaller and more numerous, much as in preceding species. Granules of *metasternum* almost entirely concealed. *Femora* edentate, front pair very stout, posterior just passing apex of first abdominal segment. Length, 12 mm.

Hab.—Queensland: Endeavour River (C. French).

On each elytron the rows of spots tend to become confused towards the base; the sutural row consists of larger but less clearly defined spots than elsewhere; the spots on the outer row are small and also rather ill-defined. On the sterna and sides of abdomen the clothing is dense, but there is a nude spot on each of the side pieces of the metasternum. The basal segment of abdomen is rather densely clothed in the middle, as well as on the sides, and the second segment has a small supplementary spot on each side. Although in general appearance quite a typical *Belus*, the scrobes are very short (not half the length of the basal joint of antennæ) and abruptly terminated; so that they could quite fairly be called foveiform.

The edentate front femora distinguish from *hemistictus* and *puncticeps*, the comparatively short rostrum and short tail from *anguineus* and *cristatus; amplicollis* is considerably larger, and has a rather prominent hump behind the scutellum. It is close to the description of *helmsi*, but the antennæ are not black, and the size is less than 7 lines.

Belus brevipes, n. sp.

Blackish-brown, apical half of rostrum and appendages more or less diluted with red; scutellum and elytra of a rather light brown, but the latter almost black at apex; third, fourth and fifth abdominal segments tipped with flavous. Clothed with pale ochreous pubescence, margining eyes, rather dense on sides of prothorax, forming a spot on the middle of its

base, and forming rows of spots on the elytra and dense but almost white on sides of under surface; abdomen in addition with a patch of pubescence in middle of basal segment and a feeble spot on each side of middle of the three following segments.

Head with dense but partially concealed punctures. Rostrum thin, the length of prothorax; with fairly coarse punctures close to base, becoming much smaller to apex. Antennæ (for the genus) not very thin, first joint almost the length of second and third combined, eleventh slightly longer than ninth and tenth combined. *Prothorax* moderately inflated towards base, median channel rather feeble, densely granulate-punctate throughout. *Scutellum* very narrow and transverse. *Elytra* flattened but scarcely depressed along suture, not suddenly raised behind scutellum; each separately strongly rounded at base, apex denticulate, feebly produced and passing abdomen for a short distance only; densely punctate-granulate throughout. *Metasternum* with a few feeble granules. Each side of each segment of *abdomen* at its base with a small, opaque, densely punctate space. *Femora* edentate, front pair very stout, hind pair not passing apex of basal abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 12 mm.

Hab.—Queensland: Cape York (H. Elgner).

The elytral spots of pubescence are small and feebly defined, but are rather numerous close to the suture; on the disc of each there is a very feeble row of small spots, and the sides are almost glabrous. There is a conspicuous nude spot on each side piece of the metasternum. Each abdominal segment in addition to the lateral spots has two small spots, except the basal segment, which has a large subtriangular median spot. The denticulations at the apex of elytra are partially concealed by short blackish pubescence. The elytra at apex are shaped much as in *brunneus*, but the two species have little else in common.

Two specimens from North-Western Australia are rather smaller (10-10½ mm.) than the type, and have the abdomen with sparse pubescence in addition to the white spots; on one of these the peculiarly punctate spaces at the bases of the segments are exactly as on the type; but on the other these spaces are almost or quite concealed by the clothing.

Belus granicollis, n. sp.

Black; apical half of rostrum, tibiæ and part of antennæ more or less obscurely diluted with red; claws of a rather bright red. Clothed with pure white pubescence, margining eyes, forming a median line, and two very feeble lateral ones,

on prothorax, dense on scutellum, and forming numerous feeble spots about suture and feebly distributed elsewhere on elytra; dense on under surface but leaving a nude spot on each side piece of metasternum, and on each side of each of the abdominal segments.

Head with dense and minute punctures at base, but rather coarse between eyes. Rostrum comparatively stout, the length of prothorax, feebly inflated at insertion of antennæ, behind which the punctures are rather dense and coarse, and in front of which they are mostly small. Antennæ somewhat inflated towards apex, first joint the length of second and third combined; second, third, fourth, and fifth of equal length *inter se*; eleventh briefly obpyriform, and shorter than ninth and tenth combined. *Prothorax* moderately inflated towards base, regularly convex, median line very feeble, disc densely the sides sparsely granulate. *Scutellum* moderately transverse. Elytra not at all depressed along suture, not suddenly raised behind scutellum, each separately strongly and somewhat angularly rounded at base; moderately produced at apex and passing abdomen for about the length of its apical segment; granulate-punctate throughout. *Femora* edentate, front pair stout, especially in female, hind pair just passing apex of first abdominal segment: front tibiæ rather strongly the others very feebly denticulate below. Length, $7\frac{1}{2}$-$8\frac{1}{2}$ mm.

Hab.—Australia (W. W. Froggatt). Given to me without exact locality by Mr. Froggatt, but probably from New South Wales or Queensland.

On the elytra of one of the specimens there appears to be a very feeble row of spots midway between the suture and each side. On the under surface the pubescence, although fairly dense in the middle, is not so dense as on the sides. The second, third, fourth, and fifth joints are of equal length, a most unusual feature, although the antennæ of *parallelus* and *acaciæ* are somewhat similar.

In general appearance close to *parallelus*, but somewhat shorter and more robust and basal segments of abdomen with nude lateral spots only; *acaciæ*, to which it is fairly close, has bidentate front femora, and is somewhat narrower; *pudicus* is larger, and has the first joint of antennæ shorter than the second and third combined.

Belus nigriceps, n. sp.

Light brownish-red; head, base of rostrum, scutellum, meso- and metasternum, base and sides of abdomen and third tarsal joint more or less black, antennæ feebly infus-

cate towards apex. Upper surface (except for a small amount of pubescence near eyes and on scutellum) glabrous; under surface with dense regular white pubescence.

Head longer than usual; punctate-granulate between eyes and densely punctate elsewhere. Rostrum slightly longer than prothorax, feebly inflated at insertion of antennæ; in male with coarse punctures and a distinct median impression behind antennæ, and impunctate elsewhere; in female without the median impression and with coarse punctures at extreme base only. Antennæ long and very thin, first and third joints subequal, eleventh shorter than ninth and tenth combined. *Prothorax* (for the genus) rather feebly inflated towards base, median channel very feeble, densely and finely granulate. *Scutellum* almost round. *Elytra* not at all depressed along suture, each separately strongly rounded at base, apex gently and regularly narrowed and passing abdomen for a very short distance; with dense punctures rather larger towards base than elsewhere, and in almost regular, closely placed rows. *Under surface* with dense but more or less concealed punctures. *Femora* edentate, front pair rather stout, especially in female, hind pair just passing apex of basal abdominal segment; tibiæ longer than usual, the front pair feebly the others very feebly denticulate below; basal joint of all the tarsi much longer than usual. Length, 8-9 mm.

Hab.—New South Wales: Forest Reefs, Armidale; Tasmania: Ulverstone (A. M. Lea).

A very thin species. The type is a male; a female differs from it in having the rostrum entirely red, and a transverse space behind the eyes diluted with red. To the naked eye there appear to be small nude spots at the sides of the abdomen, but this appearance is due solely to the colour of the derm, except in the single Tasmanian specimen, where they are really present. The elytra from some directions appear to be closely covered with rows of granules, but there are two quite regular rows of granules on the suture itself.

In general appearance remarkably close to a Western Australian species which I have identified as *acicularis*, and which has the antennæ more noticeably (although not strongly) inflated towards the apex, with the eleventh joint but little more than twice as long as wide, and the tenth much less than twice as long as wide. In the present species the eleventh joint is more than three times as long as its greatest width, and its tenth joint is slightly more than twice as long as wide. In the Western Australian specimens also the basal joint is almost black (a character not men-

tioned by Pascoe), whilst in the present species it is no darker than the rest of the antennæ. Its basal joint of tarsi is also slightly longer. It is also close to *longicornis*, but is larger and paler.

BELUS SEMIPUNCTATUS, Fab.

? cyaneipennis, Boh.
? bispinosus, Perr.

The typical form of this species has somewhat ochreous pubescence only in the subsutural depression and in a line outside of the second carina on each elytron, except for a few feeble spots near the shoulders.

It seems probable that *cyaneipennis* is a synonym of this species, despite several discrepancies in the description. The elytra of *semipunctatus* are certainly not cyaneous, although they usually have a violet or purplish gloss, and the elytra are not "almost three times the length of the prothorax," but fully four times the length. The prothorax of one large specimen measures $2\frac{2}{3}$ and the elytra 11 mm. Boheman also makes no mention of the conspicuous elytral costæ, but his description is so full and tallies in so many respects with *semipunctatus* (a quite common species about Sydney) that my surmise will probably prove to be correct.

It is also possible that *bispinosus* is a synonym, although Perrond describes the prothorax as granulate. In the typical form the prothorax could certainly not fairly be called granulate, although from certain directions certain parts of it appear to be so, owing to the density of the punctures; these, however, are quite clearly defined, and not confluent in most places. In some of the varieties, however, the prothorax might almost be called granulate-punctate.

Variety A.—Two specimens from Mackay differ from the normal form in having two additional rows of spots on each elytron; the extra rows being at the side and between the two carinæ. Their derm at the subsutural depression is also largely diluted with red, but this also occurs in forms having the typical clothing.

Variety B.—A specimen from Whitton differs from the normal form in being very small (10 mm.) and thin, and with the clothing of an almost snowy whiteness.

A specimen from Cairns agrees in its clothing with the typical form, but its elytra are of a decided green, without the least trace of violet, and the legs and abdomen are somewhat similarly coloured. The colour, however, may be due to immaturity. Another specimen from Cairns is smaller (11 mm.) than usual, and has the small sublateral spots of the abdomen absent, but this may be due to abrasion.

Belus bison, Blackb.

Three specimens under examination (two from South Australia and one from Tasmania) evidently belong to this species. In one of them the antennæ are really black, in another they are slightly diluted with red, and in the third decidedly diluted with red.

Belus tibialis, Blackb.

This species is evidently very close to *linearis*,[4] and agrees with it in the very remarkable tibiæ and tarsi. The description of the abdominal clothing, however, does not agree with specimens of *linearis* before me.

Belus amplicollis, Jekel.

Four specimens before me (from Port Denison and Moreton Bay) evidently belong to this species, but all differ in their abdominal clothing, this, however, being almost certainly due to abrasion. On a specimen, apparently in perfect condition, the abdomen is densely clothed with white pubescence at the sides from base to apex, the basal segment in addition has a large white spot on each side of middle, and the three following segments each have similar but smaller spots. In two of the other specimens faint traces of these spots can be noticed, but in one of these the clothing at the sides of the basal segment has evidently been worn away through friction with the femora; in the fourth specimen the median spots are entirely absent. With age the violet gloss of the elytra is apt to disappear.

Belus bidentatus, Don.

This species varies considerably in the intensity of its colour, some specimens being (except for the head, which is always black) of a rather pale reddish-brown, with still paler femora and tibiæ; whilst others have the derm and appendages almost entirely dark-brown. Some have numerous minute spots in addition to the two conspicuous ones on each elytron. On each elytron there are usually three carinæ, but of these only the one nearest the suture (being the third interstice raised for a portion of its length) is always distinct, the others usually being feeble and sometimes altogether wanting. The male has the rostrum behind the antennæ with denser and coarser punctures than in the female.

Belus longicornis, Lea.

Two specimens from Hobart appear to belong to this species, but differ from the type in being smaller (6 mm.),

[4] Described from Queensland; my specimens are from King George's Sound.

with paler prothorax (but not its disc), elytra and legs (but not tarsi); the antennæ are also somewhat stouter, but this may be sexual.

BELUS PUDICUS, Lea.

A specimen from Brisbane differs from the type in having the pubescence of the upper surface and on the sides of the lower surface somewhat ochreous; the elytra paler, but with the suture black. The nude space on the middle of the third and fourth abdominal segments is probably due to abrasion.

BELUS HEMISTICTUS, Germ.

This species appears to be intermediate between those having a distinct carina bounding each side of a subsutural depression and those without such. On one specimen the carina on each side of the depression is quite distinct to the naked eye, appearing as a shining line from the basal third to the apical fifth; on two others it is faintly traceable to the naked eye but practically disappears under a lens. On a fourth it is more noticeable on the right than on the left elytron. In the original description the elytra are said to be obsoletely carinate.

BELUS PHŒNICOPTERUS, Germ.

This species varies in length from 12 to 18 mm., and some specimens are much paler than others. The femoral teeth are occasionally so small as to be seen only with difficulty.

BELUS SUTURALIS, Boi.

A specimen from Western Australia is much smaller (9½ mm.) than usual, and has the pubescence of a snowy whiteness, instead of more or less stramineous.

The species of *Belus* known to me may be tabulated as follows:—

A. Basal half of elytra strongly contrasted in colour with apical half ... ... *divisus*, Pasc.
AA. Basal half not strongly contrasted.
  B. Front tibia with a strong subbasal tooth ... ... *linearis*, Pasc.
  BB. Front tibia at most denticulate.
    C. Elytra carinate.
      a. Femora edentate.
        b. Each elytron with two conspicuous spots of unequal size ... *bidentatus*, Don.
        bb. Elytral spots not isolated and conspicuous.
          c. First joint of antennæ longer than second and third combined ... ... *varipilis*, Lea.
          cc. First joint shorter than second and third combined ... ... *cristatus*, Lea

aa. Femora dentate.
d. Elytral carinæ feeble ... ... *hemistictus*, Germ.
dd. Elytral carinæ distinct.
e. Abdomen almost glabrous except for two conspicuous spots on each side ... ... *ruficornis*, Lea.
ee. Abdomen with a continuous stripe on each side ... ... *semipunctatus*, [Fab.
CC. Elytra not carinate.
D. Elytra conspicuously striped (not spotted) along suture and nowhere else.
f. Femora dentate . ... *suturalis*, Boi.
ff. Femora edentate.
g. Rostrum suddenly paler in front of antennæ ... ... *tenuis*, Lea.
gg. Rostrum nowhere suddenly paler.
h. Abdomen with two pale stripes ... ... *subsuturalis*, Lea.
hh. Abdomen with three ... *vertebralis*, Lea.
DD. Elytral clothing not as in D.
E. Suture suddenly and strongly raised at base.
i. Elytra each with a single conspicuous spot ... ... *bimaculatus*, Pasc.
ii. Elytra without such spots.
j. Elytra not strongly produced at apex.
k. Rostrum (when viewed laterally) with two colours strongly contrasted ... *grayi*, Jekel.
kk. Rostrum differently coloured ... ... *punctirostris*, Lea
jj. Elytra strongly produced at apex.
l. Prothorax with median channel wide and conspicuously interrupted in middle ... ... *pulverulentus*, Lea.
ll. Prothorax with median channel narrow and not, or scarcely, interrupted in middle.
m. Abdomen not conspicuously striped along middle ... ... *picus*, Jekel.
mm. Abdomen conspicuously striped along middle.
n. Each elytron with two stripes or rows of spots ... ... *subparallelus*, [Jekel.
nn. Each elytron with three ... ... *regalis*, Blackb.
EE. Suture not suddenly and strongly raised at base.
F. Femora dentate.
o. Elytra with conspicuous isolated ochreous spots ... *plagiatus*, Pasc.

oo. Elytra with a conspicuous mediosutural ochreous spot — *centralis*, Pasc.

ooo. Elytral spots, if present, not both conspicuous and ochreous.

p. Elytra feebly increasing in width to beyond the middle ... ... — *pictirostris*, Lea.

pp. Elytra parallel-sided or decreasing in width to beyond the middle.

q. Abdomen uniformly clothed except for nude lateral spots ... ... — *acaciæ*, Lea.

qq. Abdomen differently clothed.

r. Elytra feebly produced at apex ... ... — *brunneus*, Guer.

rr. Elytra acutely produced at apex.

s. Abdomen (for the genus) rather sparsely clothed at sides — *acrobeles*, Oll.

ss. Abdomen densely clothed at sides.

t. White clothing of abdomen (except on basal segment) confined to sides.

u. Nude spot of metasternal episternum conspicuous and transverse ... — *insipidus*, Blackb.

uu. Nude spot feeble and longitudinal ... — *phoenicopterus*, [Germ.

tt. White clothing of abdomen not confined to sides.

v. Elytra with conspicuous spots halfway between suture and sides ... — *puncticeps*, Lea.

vv. Elytra without such spots ... — *sparsus*, Germ.

FF. Femora edentate.

G. Prothorax and elytra of a rather bright chestnut-red.

w. Elytra immaculate.

x. Tenth joint of antennæ less than twice as long as wide ... ... — *acicularis*, Pasc.

xx. Tenth joint more than twice as long as wide ... — *nigriceps*, Lea.

ww. Elytra maculate on suture towards apex.
y. Head partly black ... *filus*, Jekel.
yy. Head not at all black *rubicundus*, Lea.
GG. Prothorax and elytra not both bright chestnut-red.
H. Second joint of antennæ no shorter than third.
z. Rostrum entirely dark ... *niveopilosus*, Lea.
zz. Rostrum partly red ... *granicollis*, Lea.
HH. Second joint of antennæ shorter than third.
I. Metasternal episterna without nude spots.
a. Basal joint of front tarsi almost as long as second and third combined.
b. Suture with feeble subapical spots ... *longicornis*, Lea.
bb. Suture without such spots ... ... *filiformis*, Germ.
aa. Basal joint of front tarsi much shorter than second and third combined.
c. Lateral pubescence of abdomen with nude spots ... ... *pudicus*, Lea.
cc. Lateral pubescence without nude spots *inconstans*, Lea (in part).
II. Metasternal episterna each with one or two nude spots.
J. Abdomen with four pale stripes ... ... *ganglionicus*, Pasc.
JJ. Abdomen differently clothed.
K. Elytra distinctly paler than prothorax ... ... *brevipes*, Lea.
KK. Elytra slightly, or not at all, paler than prothorax.
L. Abdomen with three nude isolated spots on basal segments ... *parallelus*, Pasc.
LL. Abdomen differently clothed.
M. Rostrum decidedly reddish on at least the apical half.
d. Elytra passing abdomen for more than length of apical segment *edentulus*, Lea.

dd. Elytra passing abdomen for a less length.
c. First joint of antennæ (if anything) slightly shorter than third — *angustulus*, Germ.
ee. First joint longer than third ... — *inconstans*, Lea (in part).
MM. Rostrum at most reddish at extreme apex only.
N. Elytral clothing (except at base) confined to suture — *scalaris*, Germ.
NN. Elytral clothing not confined to suture.
O. Elytral clothing ochreous ... — *vetustus*, Pasc.
OO. Elytral clothing white.
P. Elytra gradually and (for the genus, rather feebly produced at apex — *amplicollis*, Jekel.
PP. Elytra suddenly and strongly produced at apex
Q. Prothoracic channel narrow ... — *anguineus*, Pasc.
QQ. Prothoracic channel considerably wider — *bison*, Blackb.

Notes on above table.

D. In *scalaris* and *brunneus*, the white elytral clothing, although confined to the suture, in places appears as spots.

E. In *phœnicopterus*, *amplicollis*, *brunneus*, and some others the suture is slightly elevated at the base; but in all the species included in E the elevation is strong and sudden.

oo. In the variety *granulatus* the suture is irregularly spotted about the middle.

G. The apex of the prothorax (but not its disc) is sometimes stained with black.

HH. In *acacia* and *vetustus*, however, it is very little shorter.

RHINOTIA SIMPLICIPENNIS, n. sp.

Black, mandibles and appendages more or less diluted with red, prothorax and elytra reddish flavous, two stripes on prothorax and scutellum darker. Clothed with fine pubescence.

Head with very dense punctures. Rostrum slightly longer than prothorax and scutellum combined; with punctures behind antennæ much as on head, and with a feeble median carina or impunctate line, elsewhere with small and sparse punctures. Antennæ (for the genus) rather thin, first joint almost as long as second and third combined. *Prothorax* scarcely wider than long, sides rather feebly rounded, median line distinctly impressed on basal half only; with dense but more or less concealed punctures. *Elytra* very feebly impressed on each side of suture, apex conjointly rounded; with almost regular series of rather large punctures. *Femora* stout, the front pair stouter than the others and acutely bidentate, the teeth transversely placed, the others unidentate, posterior extending to middle of second abdominal segment; tibiæ denticulate below, the front pair very distinctly the others rather indistinctly so. Length (excluding rostrum), 8-9 mm.

Hab.—Queensland: Mackay (C. French).

The stripes on the prothorax are close together, commence at the apex and gradually narrow towards the base, which they do not quite touch, the median line towards the base is of the same colour as the stripes. The eyes are margined with ochreous pubescence above and flavous below; on the prothorax and elytra the clothing is ochreous; on the under surface and legs it varies from white, through ochreous, to black.

In general appearance close to *venusta*, but smaller, femora dentate, antennæ much thinner, with the first joint

distinctly longer than the third, eyes completely margined with pale clothing, the stripes on prothorax much paler, not conjoined at apex and the elytra nowhere black.

RHINOTIA PARVA, n. sp.

Black, basal half of elytra flavous. Clothed with short pubescence.

Head strongly convex, with very dense punctures. Rostrum comparatively short, very feebly curved, with dense punctures except at apical fourth, which is smooth and shining. Antennæ long, and not very thin, first joint not as long as second and third combined, and about half the length of eleventh. *Prothorax* more convex than usual, not much wider than long, median line absent, sides rather strongly rounded; with very dense punctures. *Scutellum* strongly transverse, feebly bilobed. *Elytra* very thin, parallel-sided to near apex, which is very distinctly denticulate; with fairly large and almost regular series of punctures; the second, fourth, and sixth interstices feebly raised. *Legs* rather thin: femora edentate, posterior extending to middle of second abdominal segment; front tibiæ feebly denticulate, the others not at all. Length, 6 mm.

Hab.—New South Wales: Tweed River (W. W. Froggatt).

The black part of the elytra is slightly advanced along the suture, and retarded at the sides, and occupies rather less than half of the surface. The eyes are margined on the front with ochreous pubescence, there is a small spot of similar clothing on each side of base of prothorax, and the pale part of the elytra has similiar clothing, the rest on the upper surface being black. On the under surface the clothing is mostly white and sparse, but is dense below the eyes and across the second, third, and fourth abdominal segments.

The smallest and thinnest species of the genus. The denticulations at the apex of the elytra are rather larger and less numerous than in *elytrura* (which has also the suture mucronate).

RHINOTIA HŒMOPTERA, Kirby.

kirbyi, Bohem.

Fresh specimens of this species have parts of the sterna clothed with a most beautiful purplish pubescence, which, however, is invisible from certain directions, and becomes obscured with age.

Two specimens from New South Wales differ from the typical form in having golden pubescence (interrupted in the middle) in the median channel of the prothorax, as well as

on the sides; and their elytra slightly smoky, although to a much less extent than in *marginella*.[5]

RHINOTIA ELYTRURA, Pasc.

This species may be readily identified by its very strongly convex metasternum and mucronate elytra. It is almost certainly the species commented upon by Lacordaire [6] as being in Paris under the name (evidently M.S.) of *spinipennis*, and as having the elytra truncate and denticulate at apex with the suture spinose.

var. BELLA, n. var.

Three specimens from New South Wales (Jenolan, Bulli, and Sydney) differ from the typical form in having the greater portion of the elytra black; the red in these specimens is confined to the margins, to a more or less small space at the apex, and then follows the line of the suture on the second and third interstices, then is confined to the second, and then at the middle becomes sutural, finally disappearing almost at the scutellum.

ISACANTHA DERMESTIVENTRIS, Boi.

fascicularis, H. & J.
pectoralis, Er. (Rhinotia).[7]
var. *fumigata*, Germ. (*Belus*).

This is a very variable species, ranging in length from 9 to 13, and in width from $2\frac{1}{2}$ to $4\frac{1}{2}$ mm. The clothing of the elytra varies from almost entirely greyish, but with a few minute dark spots, to almost entirely dark; the dark clothing is generally in spots (many of which have a velvety appearance) of which there is often a large one on each side of suture about the middle. Ochreous pubescence is often scattered about and sometimes rather thickly so on the suture. On one Victorian specimen the surface (more noticeably towards the suture than elsewhere) is thickly covered with small white spots, many of which are somewhat ochreous (although not at all eye-like in character) at the sides. The clothing on the prothorax is also variable. The rostrum varies

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[5] This species is very close to *hæmoptera*, but apart from its smoky elytra it may be distinguished by the terminal joint of its antennæ being longer and by its somewhat more prominent post-scutellar hump.

[6] Gen. Coleop., VI., p. 526, note 1.

[7] A rather curious mistake occurs in Erichson's description of this insect. He says "Coleoptera thorace paulo *longiora*," evidently meaning "*latiora*"; as the elytra are more than thrice the length of the prothorax.

from reddish-brown to black, and is often diluted with red at the apex and sides. The prothorax in some specimens is much more conspicuously inflated at the base than in others.

The appearance of the specimens is often considerably altered by immersion in alcohol and by abrasion.

ISACANTHA RHINOTIOIDES, Hope.

congesta, Pasc.

This species has been redescribed by Pascoe under the name of *congesta;* it is to be noted that the appearance of the upper surface is considerably altered by alcohol. But it is readily distinguished from all others of the subfamily known to me by the clothing of the metasternum. In several collections I have seen the name *rhinotioides* applied to *dermestiventris*, which, however, has the metasternal clothing very different.

ISACANTHA PAPULOSA, Pasc.

The conspicuous spotting of the elytra of this species is subject to great alteration with age and abrasion, etc.

SUBFAMILY TYCHIIDES.

ELLESCHODES PICTUS, n. sp.

Black; head, rostrum, antennæ, shoulders and apex of elytra, tibiæ, tarsi, and parts of femora more or less red. Upper surface with stout white setæ in spots or patches, the interspaces with fine, dark, and indistinct pubescence; under surface and legs with whitish pubescence, denser on sides of meso- and metasturnum than elsewhere.

Rostrum not very thin, the length of prothorax in male, very little longer in female, moderately curved; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially concealed behind antennæ in male, at base only in female. Antennæ rather thin, inserted one-third from apex of rostrum in male, two-fifths in female. *Prothorax* about once and one third as wide as long, with traces of a very feeble median carina; with very dense, round, and (except beneath spots of setæ) well-defined punctures. *Elytra* cordate, hardly parallel-sided anywhere; seriate (scarcely striate) punctate, punctures of moderate size but smaller towards suture than sides; interstices fairly wide, not separately convex, with small scattered punctures. *Abdomen* with dense, partially concealed punctures. *Femora* rather stout, very feebly dentate. Length, $2\frac{1}{4}$ mm.

Hab.—New South Wales: Forest Reefs, Glen Innes (A. M. Lea).

The reddish parts of the elytra are not sharply limited, and in one specimen the red from the shoulder is obscurely connected with the apex; in another the apex is scarcely paler than the rest of the elytra; the femora, especially the hind pair, are more or less diluted with red. There is a very distinct white spot of setæ between the eyes, and three at the base of the prothorax; on the elytra the white setæ form distinct patches, which are sometimes broken up into feeble spots; but in the normal form they appear to clothe the suture at the base and near the apex, and to form two feeble transverse fasciæ—a very irregular subbasal one (at times so loosely formed as almost to cover the basal third) and a more regular but shorter one at summit of posterior declivity; there are generally also white setæ on the slight preapical callosities.

The three patches of snowy-white setæ at the base of the black prothorax render this species very distinct, although it is closely allied to *eucalypti*.

ELLESCHODES MODICUS, n. sp.

Black; head, rostrum, antennæ, and legs (the femora more or less deeply stained with black) more or less red. Clothed with setæ or pubescence, white on the under surface and legs, variegated on the upper surface.

Rostrum and antennæ as in preceding species. *Prothorax* and *elytra* much the same, except that the prothorax is slightly wider, and its punctures are slightly less numerous and more obscured by the clothing. *Abdomen* and *femora* much the same, except that the femoral dentition is somewhat stronger. Length, 2-2¼ mm.

Hab.—New South Wales: Armidale (A. M. Lea).

The elytra are more or less diluted with red on each side of the base, and there is a rather indistinct subquadrate reddish patch at the apex; the head is sometimes darker than the rostrum. There is a rather dense patch of straw-coloured clothing between the eyes; the prothorax is similarly clothed except that there is a darker spot (sometimes very indistinct) on each side of middle. On the elytra the straw-coloured clothing is nowhere condensed into distinct spots, but is fairly dense in parts; there are also white setæ, placed much as they are in the preceding species.

The species certainly belongs to the *eucalypti* group, but the clothing on the elytra is denser and more uniform in extent, although somewhat variable in colour, than on any of the close allies of that species. The prothorax and legs are differently coloured to those of *eucalypti* itself.

ELLESCHODES RUFULUS, n. sp.

Male. Dull reddish-brown. Densely clothed with straw-coloured setæ, with feeble darker spots; scutellum with dense whitish clothing. Under surface and legs with fairly dense whitish clothing.

Rostrum thin, slightly longer than prothorax and lightly curved; with a thin median carina, and with four very feeble ones caused by rows of punctures; sculpture almost concealed on basal half; antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* about once and one half as wide as long, punctures normally concealed. *Elytra* elongate-cordate, nowhere parallel-sided; with series of not very large but almost regular punctures; interstices not separately convex, with small concealed punctures. *Abdomen* with dense and regular punctures. *Femora* stout, rather strongly and acutely dentate. Length, $2\frac{1}{2}$ mm.

Hab.—Victoria: Wangaratta (A. M. Lea).

On the prothorax of the type the darker spots amongst the pubescence are very indistinct; but on the elytra they are fairly distinct and about forty in number.

A specimen obtained at the same time as the type is probably the female, it differs in being larger, in having the dark elytral clothing covering most of the surface, the paler clothing covering the base only, except for a few indistinct spots posteriorly, the rostrum thinner and decidedly longer, and the antennæ inserted almost in exact middle of sides of rostrum.

ELLESCHODES SUTURALIS, n. sp.

Of a rather pale reddish-brown. Clothed with whitish setæ or pubescence, dense on sides and middle of prothorax and on suture.

Rostrum thin, curved; in male slightly longer than prothorax and longer in female than in male; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially concealed on basal third in male, at base only in female. Antennæ thin, inserted about two-fifths from apex of rostrum. *Prothorax* about once and one third as wide as long; with dense, round, more or less concealed punctures. *Elytra* rather elongate-cordate, nowhere parallel-sided; with series of not very large punctures, but becoming larger towards base and sides; interstices not separately convex, with small and usually concealed punctures. Abdomen with dense partially concealed punctures. *Femora* moderately stout, very feebly dentate. Length, $1\frac{3}{4}$-2 mm.

Hab.—New South Wales: Galston (A. M. Lea).

Of three specimens one has the metasternum almost black, whilst in the two others it is darker than the rest of the under surface but not infuscated. The three whitish prothoracic lines are distinct, but rather wider and not so densely formed as the sutural one. The clothing of both surfaces is practically of one shade of colour.

ELLESCHODES UNIFORMIS, n. sp.

Reddish-brown, scutellum, suture (very narrowly), and sides near base, sterna, and three basal segments of abdomen black; club infuscate. Moderately densely and almost uniformly clothed with whitish pubescence or setæ, paler on the under surface than elsewhere.

Rostrum thin, lightly curved, in male distinctly longer than prothorax, and slightly longer in female than in male; with a thin median carina, and with four very feeble ones caused by rows of punctures; sculpture partially concealed behind antennæ in male, at extreme base only in female. Antennæ thin, inserted one-third from apex of rostrum in male, two-fifths in female. *Prothorax* about once and one third as wide as long; with dense but normally concealed punctures; apparently with traces of a feeble median carina. *Elytra* elongate-cordate, parallel-sided for a short distance near base; with series of rather large punctures (larger towards base and sides than elsewhere), in rather shallow striæ; interstices feebly separately convex, with small but usually concealed punctures. *Abdomen* with dense regular partially concealed punctures. *Femora* moderately stout, very feebly dentate, especially in female. Length, 2 mm.

Hab.—Tasmania: Hobart (A. M. Lea).

On two out of three specimens the clothing on the elytra is denser on the third, and to a less extent on the fifth and seventh interstices than elsewhere, but the elytra do not appear to be distinctly striped. The second, third, and fourth abdominal segments are scarcely produced backwards at the sides, a character which will readily distinguish the species from all others known to me.

ELLESCHODES BRYOPHAGUS, n. sp.

Chestnut-brown; suture and sides of elytra near base and parts of under surface black. Clothed with rather thin greyish pubescence, denser and paler on scutellum than elsewhere.

Rostrum rather stout, feebly curved; in male the length of prothorax, in female slightly longer and thinner than in male; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially con-

cealed on basal half in male, at base only in female. Antennæ thin, inserted one-fourth from apex of rostrum in male, one-third in female. *Prothorax* depressed, about once and one-half as wide as long; with small and dense but more or less concealed punctures. *Elytra* elongate-cordate, parallel-sided from near the base to beyond the middle; with series of small and rather narrow punctures, becoming larger (but not large) and more rounded towards base and sides; interstices not separately convex, with small and more or less concealed punctures. *Abdomen* with dense punctures, larger and sparser on basal and denser on apical segment than on the others. *Femora* stout and feebly (especially the front pair) dentate. Length, 2-2½ mm.

Hab.—Tasmania: Mount Wellington, Hobart (in moss, A. M. Lea).

An elongate, depressed form, with the elytra somewhat wider than the prothorax than is usual. The meso- and metasternum appear to be always black. The two basal segments of the abdomen are sometimes no darker than the others, but are sometimes (and especially the first one) deeply infuscated. From some directions the pubescence or setæ appears to have a faint golden gloss; on the elytra it is not quite depressed, and it is denser on the upper than on the under surface. Except towards the sides, there is an almost complete absence of striation from the elytra.

ELLESCHODES SIMILIS, n. sp.

Female (?). Dark reddish-brown; rostrum and appendages paler, under surface black. Moderately densely clothed with greyish pubescence, becoming whitish on under surface and legs.

Rostrum thin, moderately curved, slightly longer than prothorax; with a fine median carina and with four feeble ones caused by rows of punctures; sculpture not concealed by clothing. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* depressed, about once and two thirds as wide as long; with small, dense, and only partially concealed punctures. *Elytra* elongate-cordate, scarcely parallel-sided anywhere; punctures and interstices much as in preceding species. *Abdomen* with rather more regular punctures than in the preceding species, but the femora much the same. Length, 2½ mm.

Hab.—Tasmania: Mount Wellington (in moss, A. M. Lea).

Close to the preceding species, but darker and wider, elytra less parallel-sided and not so wide in proportion to the prothorax, and the prothoracic punctures less concealed. The

clothing is much the same, but is darker on the upper and paler on the lower surface, on the elytra also it is feebly variegated with single but rather thickly scattered paler setæ. The rostrum is more strongly and uniformly curved, and the antennæ are inserted at a greater distance from the apex.

ELLESCHODES PALLIDUS, n. sp.

Pale testaceous. Moderately clothed with straw-coloured or slightly golden pubescence.

Rostrum thin, moderately curved, slightly longer than prothorax, parallel-sided; behind antennæ with a fine median carina and with others caused by rows of punctures, in front of antennæ with fine punctures only. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* depressed, almost twice as wide as long, widest (but not by much) slightly in advance of middle; with dense but more or less concealed punctures. *Elytra* elongate-cordate, parallel-sided from near base to beyond the middle; punctures and interstices almost exactly as in *ellipticus*. *Abdomen* with moderately dense and only partially concealed punctures; apical segment depressed in middle. *Femora* stout and feebly (especially the front pair) dentate. Length, 2-2¼ mm.

Hab.—South Australia (Macleay Museum).

On the elytra of one of the two specimens before me (both apparently of one sex) some of the pubescence is of a brownish colour, but it is very indistinct, and the clothing everywhere is very similar in colour to the derm on which it rests.

ELLESCHODES SCUTELLARIS, n. sp.

Bright red; scutellum black; suture and parts of sterna more or less infuscated. Moderately, in places sparsely, clothed with short whitish pubescence.

Rostrum thin, moderately curved, longer than prothorax; with a fine carina behind antennæ, and with other very feeble ones caused by rows of punctures; in front of antennæ with fine punctures only. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* somewhat depressed, about once and one third as wide as long; with numerous round and only partially concealed punctures. *Elytra* cordate, nowhere parallel-sided; with series of not very large punctures (larger towards base and sides than elsewhere) in rather feeble striæ; interstices feebly separately convex, with small and rather numerous, but more or less concealed punctures. *Abdomen* with moderately dense and distinct punctures. *Femora* stout, feebly but acutely dentate. Length, 2-2¼ mm.

Hab.—Western Australia: Swan River (A. M. Lea).

In general appearance somewhat close to the preceding species, but prothorax larger and the sides less rounded, scutellum black, etc. In colour (except of under surface) it somewhat resembles *bryophagus*, but it is much more robust than that species. The two specimens described are apparently females.

ELLESCHODES PLACIDUS, n. sp.

Reddish-castaneous. Densely clothed with straw-coloured pubescence or setæ, sparser and paler on the under than on the upper surface.

Rostrum (for the genus) rather stout, moderately curved, slightly longer than prothorax; behind antennæ with a fine median carina, and with rather coarse rows of punctures, in front of antennæ with distinct punctures only, and feebly decreasing in width to apex. Antennæ (for the genus) not very thin, inserted two-fifths from apex of rostrum. *Prothorax* about once and two thirds as wide as long; with dense, round, partially concealed punctures. *Elytra* elongate-cordate, parallel-sided from near base to about the middle; with series of fairly large punctures in rather feeble striæ; interstices feebly separately convex, with small dense and partially concealed punctures. Abdomen with dense, partially concealed punctures. *Femora* very stout, strongly and acutely dentate. Length, $3\frac{1}{4}$ mm.

Hab.—Western Australia: Karridale (A. M Lea), King George's Sound (Macleay Museum).

On two of the four specimens before me the clothing is absent from the middle of the prothorax, and from a sub-triangular space behind the scutellum, but this appears to be due to abrasion.

ELLESCHODES COMPACTUS, n. sp.

Of a rather bright red; sterna black; moderately clothed with rather loosely applied pubescence or setæ, whitish on sterna, straw-coloured elsewhere, and longer on prothorax than on elytra.

Rostrum thin, feebly curved on its upper surface, almost straight on its lower, feebly but regularly decreasing in width from base to apex; behind antennæ in male with rather coarse but concealed sculpture (in female at base only), in front of antennæ with fairly distinct punctures in male, but very fine ones in female. Antennæ rather thin, inserted slightly nearer base than apex in male, and nearer the base in female; scape about half the length of funicle; funicle with first joint as long as second and third combined, second longer than third; club oval, distinctly jointed. *Prothorax*

convex, sides strongly rounded, about once and two thirds as wide as long, apex incurved to middle, base not bisinuate but very feebly and continuously rounded; with dense, round, partially concealed punctures. *Elytra* cordate, wide, strongly convex, parallel-sided from near the base to about the middle, shoulders rounded; with series of large punctures in rather shallow striæ, interstices feebly separately convex, with fairly large but partially concealed punctures. *Abdomen* strongly convex; with rather coarse partially concealed punctures; suture between first and second segments almost as distinct across middle as at sides. *Femora* stout, strongly and acutely dentate; tibiæ with a fringe of teeth at apex; each claw with a stout supplementary basal piece. Length, $2\frac{3}{4}$-3 mm.

Hab.—New South Wales: National Park (H. J. Carter), Sydney (A. M. Lea).

The colour as described is that of three specimens, but in a fourth the head, base of rostrum, scutellum, apex of prothorax, and sides of elytra are also black, and the suture is slightly infuscated; in a fifth the sides of the elytra and the under surface of the head are infuscated. The pubescence on the elytra is rather denser on the third, fifth, and seventh interstices than on the others, but it is not sufficiently dense to cause the appearance of distinct stripes.

This and the following species will probably not rest in *Elleschodes*, but at present no good purpose would be served by proposing a special genus for their reception.

ELLESCHODES NIGIROSTRIS, n. sp.

Bright red; head, rostrum, funicle, club, front femora, and tibiæ, and middle femora black or blackish. Elytra moderately densely clothed with golden or straw-coloured pubescence or setæ, some of which are suberect; elsewhere more or less sparsely clothed.

Rostrum rather stout, moderately curved, slightly longer than prothorax, parallel-sided; behind antennæ with a feeble median carina and with distinct rows of punctures; in front of antennæ with distinct punctures only, and these not in regular rows. Antennæ thin, inserted about two-fifths from apex of rostrum; scape more than half the length of funicle and club combined; funicle with first joint as long as second and third combined, second longer than third; club elongate-ovate, rather loosely jointed. *Prothorax* convex, about once and one third as wide as long, sides rounded but decreasing in width from base to apex, apex truncate, base not bisinuate but gently and continuously rounded; with dense, round, and rather small punctures; with a very feeble median carina or impunctate line. *Elytra* subcordate, strongly convex, wide,

nowhere parallel-sided, shoulders embracing prothorax; with series of large, subquadrate punctures; interstices feebly separately convex only towards base and sides, with rather dense but partially concealed punctures. *Abdomen* and *femora* much as in preceding species, except that the abdominal punctures are rather smaller but less concealed. Length, 3½ mm.

Hab.—Queensland: Brisbane (R. Illidge).

Allied to the preceding species, and with similar claws, and probably also variable in colour, but I have but one specimen (probably a male) to judge from. The shape of the rostrum, the length of the scape, and the shoulders (apart from colours) will readily distinguish the two species. The elytra are rather densely clothed, but from some directions appear to be almost glabrous; possibly the prothorax and head of the type are partly abraded.

HIBBERTICOLA, n.g.

Head rather large, but not wide. Eyes of moderate size, rather distinct, finely faceted. Rostrum short and stout; scrobes oblique, directed beneath eyes, their tips not visible from above. Antennæ rather short; scape rather thin; funicle seven-jointed, basal joint rather large; club briefly ovate, joints fairly distinct. Prothorax moderately transverse, base not bisinuate; without ocular lobes. Scutellum small. Elytra cordate. Metasternum rather short. Abdomen with suture between first and second segments feeble, across middle, second, third, and fourth rather feebly drawn backwards at sides, fifth rather small. Legs rather stout; femora edentate; tibiæ almost straight; claws appendiculate.

The finely faceted eyes will readily distinguish this from the other Australian genera of the subfamily. The male has a distinct pygidium, and which encroaches upon the middle of the apical segment of abdomen. In the female the pygidium is concealed, and the apical segment of abdomen is rounded at its apex. The only known species lives in galls on *Hibbertia sericea*, and Mr. Griffith writes me of it:—"I have only seen the gall around Black Hill, Athelstone, but *H. sericea* is a common enough plant on our hills, so probably the gall is to be found all around. These galls are very plentiful at base of Black Hill, and the beetle is abundant. I know nothing of the habits of the weevil beyond the fact that they are always *in* the gall, sometimes two or three in a large one, yet so far I have found no more than one larva in each gall, and have opened a good many scores, large and small."

HIBBERTICOLA ECHINATA, n. sp.

Reddish-castaneous. Rather densely clothed with loose pubescence or setæ, whitish on the under surface, straw-coloured or slightly golden on the upper; the elytra in addition with dense, more or less erect setæ.

Head with rather numerous punctures. Rostrum short (scarcely more than half the length of prothorax), stout, straight, parallel-sided; with rather coarse but partially concealed punctures on basal half, and finer but less concealed on apical half. Antennæ rather thin, inserted almost in exact middle of sides of rostrum; scape almost the length of funicle; funicle with first joint stout, the length of second and third combined; club briefly ovate, rather indistinctly jointed. *Prothorax* about once and one third as wide as long, rather strongly convex, sides rounded, apex truncate, base gently and continuously rounded; with dense, round, partially concealed punctures. *Elytra* somewhat elongate-cordate, each separately rounded at base, nowhere quite parallel-sided; with series of fairly large punctures, in distinct striæ; interstices separately convex, with fairly numerous punctures. *Abdomen* with very dense but more or less concealed punctures. Length, $1\frac{4}{5}$-$2\frac{1}{2}$ mm.

Hab.—South Australia: Athelstone (H. H. D. Griffith).

The club is infuscated or almost black, but is sometimes no darker than the rest of the antennæ. Some specimens are slightly darker than others, and some parts are slightly darker than other parts; but (except for the club) no parts are black or even deeply infuscated. The disc of the prothorax in all the numerous specimens examined is glabrous. The erect elytral setæ are dense and apparently irregularly distributed, but when viewed from behind or the front are seen to be in regular lines. The punctures, both on the interstices and in the striæ, are partially concealed by the clothing.

SELLECHUS, n.g.

Head of moderate size. Eyes rather large, coarsely faceted, moderately distant. Rostrum moderately long and thin; scrobes lateral, their commencement scarcely visible from above. Antennæ rather thin; scape rather long; funicle seven-jointed, basal joint large; club ovate, joints distinct. Prothorax transverse, base feebly bisinuate, ocular lobes very obtuse. Scutellum small. Elytra cordate. Metasternum moderately long. Abdomen with suture between first and second segments feeble, across middle, second, third, and fourth drawn backwards at sides, fifth rather large. Legs stout; femora edentate; four front tibiæ of male suddenly excavated

towards apex; each claw with a rather stout supplementary piece at the base.

Readily distinguished from all Australian genera of the subfamily by the remarkable structure of the male tibiæ, which is described at length under the species.

SELLECHUS TIBIALIS, n. sp.

Black; antennæ (the club excepted), tibiæ, and tarsi reddish, rostrum obscurely diluted with red towards the apex. Upper surface rather densely clothed with short dark pubescence or setæ, with paler setæ or pubescence scattered about, and sometimes condensed into small spots at the junction of the prothorax and elytra. Under surface, legs, head between eyes, and base of rostrum, with whitish pubescence. Tibiæ of male, and especially the hind pair, with long golden hair towards the apex.

Head with dense but more or less concealed punctures. Rostrum thin, moderately curved, about the length of prothorax; with a fine median continuous carina, and with rows of punctures, becoming very irregular, however, in front of antennæ; sculpture on basal half more or less concealed in male, on basal fifth only in female. Antennæ thin, in male inserted about one-fourth from apex of rostrum, in female almost in exact middle of sides; scape almost the length of funicle in male, but shorter in female; two basal joints of funicle elongate, but first longer than second; club elliptic-ovate. *Prothorax* rather feebly convex, about once and one fourth as wide as long, apex much narrower than base; with dense, rather fine and partially concealed punctures; usually with traces of a very feeble median carina. *Elytra* elongate-cordate, almost parallel-sided from near the base to middle; with series of rather small punctures; interstices, except towards apex and sides, not separately convex, with small and more or less concealed punctures. *Under surface* of male with a wide shallow depression, continuous from near base of metasternum to near apex of abdomen; in female this space flattened. *Femora* stouter and more curved in male than in female. Length, $2\frac{1}{3}$-3 mm.

Hab.—New South Wales: Tamworth (A. M. Lea).

Two of the eight specimens examined are of a piceous brown, but all the others are of a deep black. To the naked eye the upper surface appears to be of a rather dingy black. The rostrum of the female is thinner and with much finer sculpture than that of the male, its widest part is at the base, and thence it is parallel-sided to the apex; in the male its widest part is between the antennæ and apex. Except towards the apex and sides there is a complete absence of

elytral striation. The front tibiæ of the male are suddenly and largely excavated near the apex, so that the apical portion from some directions appears to form a rather large basal tarsal joint; projecting over the excavation from the lower edge is a strong obtuse tooth. The middle pair are rather strongly emarginated on the lower surface towards the apex, and behind the emargination are some long golden hairs. The hind pair are stout, somewhat curved, and also with long golden hairs. The female tibiæ are quite simple. The excavation of the under surface of the male is bounded by denser clothing than elsewhere.

ELLESCHUS CONCINNUS, n. sp.

Black, appendages reddish; rostrum sometimes entirely reddish, sometimes infuscated on the basal half, and sometimes on the sides of the basal half. Head, base of rostrum, prothorax, scutellum, and a spot on elytra, with straw-coloured or golden pubescence; rest of elytra with greyish or brownish pubescence; under surface and legs with white pubescence.

Rostrum in male moderately stout and curved, slightly longer than prothorax, behind antennæ with a fine median carina and rather coarse but concealed punctures, in front of antennæ with fairly distinct punctures; in female the rostrum is longer and thinner, and the punctures are smaller and less numerous but concealed only at the basal fifth. Antennæ thin, inserted about two-fifths from apex of rostrum in male, nearer the middle in female. *Prothorax* about once and one half as wide as long, with dense, concealed punctures. *Elytra* cordate, nowhere parallel-sided; with series of rather small punctures (but fairly large at base and sides) in feeble striæ; interstices not separately convex, except at sides and apex, with small and usually concealed punctures. *Abdomen* with rather dense partially concealed punctures. *Femora* moderately stout, edentate. Length, 1½-2 mm.

Hab.—New South Wales: Forest Reefs, Inverell, Tamworth (A. M. Lea).

The head is sometimes not black, but of a rather deep brown. The pale spot of clothing on the elytra is distinct in the four specimens examined, but is more sharply defined in some than in others; it appears to be transversely oblong in shape, and is situated on the suture at about the basal third, and extends across three interstices on each elytron; in two specimens it is feebly connected with the shoulders. On the prothorax the pubescence is so directed as to cause a fairly distinct median line where it meets. Each claw appears deeply cleft under the microscope.

ELLESCHUS WELLINGTONIENSIS, n. sp.

Reddish-testaceous; under surface black, but apex of abdomen diluted with red. Rather densely clothed with straw-coloured or slightly golden pubescence or setæ; becoming sparser and paler on under surface, both of body and legs.

Rostrum rather stout, feebly curved, distinctly shorter than prothorax, narrow near base and then rather strongly inflated; with fairly dense and distinct punctures on apical half, but concealed on basal half. Antennæ stout, inserted about one-third from apex of rostrum; scape about half the length of funicle and club combined. *Prothorax* feebly convex, about once and one half as wide as long, sides rounded and decreasing in width from near base to apex, base feebly and continuously rounded; with small, dense, and usually concealed punctures; with traces of a very feeble median carina. *Elytra* elongate-cordate, scarcely parallel-sided anywhere; with series of fairly large punctures in feeble striæ; interstices feebly separately convex, with fairly numerous but usually concealed punctures. *Abdomen* with rather fine and partially concealed punctures. Femora stout, edentate. Length, 3 mm.

Hab.—Tasmania: Summit of Mount Wellington (A. M. Lea).

The type is evidently a male. There are four other specimens (also taken on the summit of Mount Wellington) before me, which are possibly females, but the rostrum is of very different shape, being quite straight, parallel-sided from base to apex, thinner and longer. The antennæ (and more noticeably the scape) are thinner and inserted almost in exact middle of sides of rostrum. The clothing is much the same but rather paler. The colour of the abdomen of one of these is exactly as in the type; in another only its base is infuscated; the two others being intermediate.

A Contribution to the Botany of South Australia

By J. H. Maiden, Honorary Member.

[Read September 8, 1908.]

Introductory.

South Australia will ever be of especial interest to the Australian botanist, because it was the first *terra incognita* that Robert Brown explored (coastally). He was with Flinders on his voyage of discovery, but the Australian land first touched by that navigator, South-Western Australia, had been previously visited, and some attention had been given to its botany; but in South Australia Brown was the first botanist to see its plants (with the reservation, as regards Leschenault de la Tour, who visited, it is believed, a portion of Eastern South Australia).(1)

The Association for the Advancement of Science met at Adelaide in January, 1907, and the Government of South Australia graciously placed the steamer "Governor Musgrave," Captain P. Weir, at the disposal of a limited number of local and visiting naturalists, in order that certain places rich in historical associations or promising useful scientific collections might be visited. The following formed the party:—*South Australia*—Mr. Thomas Gill, I.S.O., Dr. R. S. Rogers, Dr. W. Torr, Messrs. W. Howchin, D. Mawson, B. S. Roach, and J. W. Mellor; *Victoria*—Professors R. Berry and E. W. Skeats, and Mr. Sweet; *New South Wales*—Rev. Clement Wilkinson, Mr. Charles Hedley, Dr. W. G. Woolnough, Messrs. J. Clunies Ross, T. G. Taylor, and the writer.

It will thus be observed that various sciences were represented, and valuable observations and collections were the result of the cruise. Mr. Thomas Gill and Dr. R. S. Rogers were my special mates for botany, and I am very grateful to them for the unselfish help they gave me. The latter has since sent me specimens from some of the places visited by us, and also from other South Australian localities; these have been incorporated in the present paper, which is an expression of gratitude and an indication that the hospitality of the South Australian Government has not been bestowed in vain. I would remark that the foregatherings of scientific men from various States on occasions like these promote good fellowship and make for the advancement of science.

I was landed alone by the "Governor Musgrave" at Port Lincoln, and spent several days in that botanically rich dis-

(1) Select Bibliography (2).

trict, the scene of collecting trips by Robert Brown in 1802. On the north I went nearly as far as Tumby Bay, and on the west to Coffin Bay.

Proceeding up Spencer Gulf by steamer to Port Augusta I spent a day there.

This paper is mainly a contribution to the local florulas of South Australia. I much felt the want of such for the places I visited, and incomplete as those are which I submit, I hope they may prove useful. No record has been admitted into any of the lists for which a herbarium specimen is not available. Imperfect as they are, they will serve as a hint for other naturalists to amplify them, for we have much to learn in regard to the geographical distribution of species in South Australia, as, indeed, in the other States.

The genera Eucalyptus and Acacia have been separately dealt with as a matter of convenience.

Select Bibliography.

(1) "The Botany of Kangaroo Island," by Ralph Tate (Tr.R.S.S.A., vol. vi., p. 116 [1883]).

See the bibliography of the flora of Kangaroo Island enumerated in (2).

(2) Presidential Address, Biology Section, Australian Association for the Advancement of Science, Adelaide, 1907

It will be convenient to refer to certain papers on the Euronotian Region under Y and L enumerated in (2).

For the plants from the following localities—Coobowie and Edithburgh (Yorke Peninsula); Althorpes; Cape Borda; South Neptunes: Port Elliston (Port Waterloo): Flinders Island: Fowler Bay: Point Sinclair (LeHunte Bay): Davenport River: Bird Rock: Murat Bay; Denial Bay: Laura Bay: Flagstaff Landing; Streaky Bay; Venus Harbour: Taylor Island: Cape Donington: Port Lincoln: Dangerous Reef: Althorpes (second visit): Rhino Point and the wrecked "Willyama": Marion Bay: and Port Moorowie—I am indebted to Dr. R. S. Rogers.

Kangaroo Island.

KINGSCOTE.

* Denotes an alien species. Compare Tate (1).

(**T**) Denotes also native of Tasmania.

Resedaceæ—* Reseda alba, *L.* A roadside weed.

Geraniaceæ—(**T**) Pelargonium australe, *Willd.*

Myrtaceæ—(**T**) Melaleuca squarrosa, *Don:* Melaleuca parviflora, *Lindl.*

Compositæ—(**T**) Cassinia spectabilis, *R. Br.:* Helichrysum retusum, *Sond.* and *F. v. M.:* Olearia rudis, *F. v. M.* (Aster exsul), Ray florets blue, viscid leaves, 2-3 ft. high.

(T) Senecio odoratus, *Hornem.* (T) Vittadinia australis, *A. Rich.*

Apocynaceæ—(T) Alyxia buxifolia, *R. Br.*

Solanaceæ—(*?) Solanum nigrum, *L.* Lycium australe, *F. v. M.*

Myoporaceæ—Eremophila Brownii, *F. v. M.* Viscid leaves, red flowers.

Labiatæ—* Marrubium vulgare, *L.*

Chenopodiaceæ—(T) Salicornia australis, *Sol.*

Thymelæaceæ—Pimelea sp. 3-3 ft. 6. in. high, very abundant, but not in flower.

Santalaceæ—Choretrum glomeratum, *R. Br.* This may be C. chrysanthum, *F. v. M.* Bentham unites C. glomeratum and C. chrysanthum. Mueller and Tate keep them distinct, but I can see no other difference than that the flowers are yellow in C. chrysanthum and white in C. glomeratum.

Liliaceæ—(T) Dianella revoluta, *R. Br.* Tate has D. lævis only.

Gramineæ—(T) Danthonia penicillata, *F. v. M.*, var. setacea. * Lagurus ovatus, *L.* Well acclimatized.

HOG BAY.

Ranunculaceæ—(T) Clematis microphylla, *DC.*

Dilleniaceæ—(T) Hibbertia stricta, *R. Br.*

Pittosporaceæ—Billardiera. (T) Bursaria spinosa, *Cav.*

Sterculiaceæ—Lasiopetalum Baueri, *Steetz.*

Zygophyllaceæ—Nitraria Schoberi, *L.*

Geraniaceæ—(T) Pelargonium australe, *Willd.*

Rutaceæ—(T) Correa speciosa, *Ait.* Locally called "Honeysuckle."

Rhamnaceæ — (T) Spyridium eriocephalum, *Fenzl.* Broad-leaved form, apparently an addition to the flora of the island. (From J. M. Black.) Spyridium spathulatum, *F. v. M.* The great viscidity of the flowers is not mentioned in the "Flora Australiensis." (T) Spyridium vexilliferum, *Reiss.* (J. M. Black).

Sapindaceæ—Dodonæa viscosa, *L.*, var. attenuata.

Leguminiosæ—(T) Goodia lotifolia, *Salisb.* I have seen Tate's specimen, and it is identical with my own. Tate labelled his specimen G. medicaginea, *F. v. M.* I follow Bentham in reducing medicaginea to lotifolia; I cannot see any difference between the Kangaroo Island plant and the common Eastern Australian one (Salisbury's plant). G. medicaginea should be dropped from the South Australian flora and G. lotifolia substituted.

Rosaceæ—(T) Acæna sanguisorbæ, *Vahl.*

Myrtaceæ—Callistemon coccineus, *F. v. M.* (T) Melaleuca gibbosa, *Labill.*: Melaleuca uncinata, *R. Br.*

AIZOACEÆ—(T) Mesembryanthemum æquilaterale, *Haw.*

UMBELLIFERÆ—(T) Apium prostratum, *Labill.*

RUBIACEÆ—Opercularia hispida, *Spr.* Determination doubtful. The seeds are like those of O. aspera, but the habit and other characters are like O. hispida.

COMPOSITÆ—(T) Calocephalus Brownii, *F. v. M.* * Carduus lanceolatus, *L.* * Carduus marianus, *L.* * Centaurea melitensis, *L.*, called "Cockspur" on Kangaroo Island. (T) Cotula coronopifolia, *L.* * Cryptostemma calendulacea, *R. Br.* (T) Gnaphalium japonicum, *Thunb.*; Helichrysum retusum, *Sond.* and *F. v. M.* (T) Ixiolæna supina, *F. v. M.* A white or pale purple, weak, trailing plant at Frenchman's Rock: Ixodia achilleoides, *R. Br.* (I. alata, *Schlecht*). (T) Olearia ramulosa, *Labill.*; Olearia teretifolia, *F. v. M.*

GOODENIACEÆ—(T) Goodenia ovata, *Sm.* (T) Scævola microcarpa, *Cav.* (?) New for the island.

PRIMULACEÆ—* Anagallis arvensis, *L.*

GENTIANACEÆ—(T) Erythræa australis, *R. Br.*

SOLANACEÆ—Lycium australe, *F. v. M.*: *Solanum sodomæum, *L.*

MYOPORACEÆ—(T) Myoporum insulare, *R. Br.*

POLYGONACEÆ—(T) Mühlenbeckia adpressa, *Meissn.* The roots are boiled and the plant known as "Sarsaparilla."

PROTEACEÆ—(T) Hakea rostrata, *F. v. M.*

CASUARINACEÆ—(T) Casuarina distyla, *Vent.* (T) Casuarina stricta, *Ait.*

CONIFERÆ—(T) Callitris cupressiformis, *Vent.*; Callitris propinqua, *R. Br.* (W. Gill). See my "Forest Flora of New South Wales," part xii., p. 54. Tate records C. verrucosa (doubtless this plant) from Kangaroo Island, but there is no evidence satisfactory to me of the occurrence of true C. verrucosa on the island.

IRIDACEÆ—Sisyrinchium cyaneum, *Lindl.*

LILIACEÆ—(T) Bulbine semibarbata, *Haw.* (T) Dianella revoluta, *R. Br.*: Thysanotus dichotomus, *R. Br.*: Xanthorrhœa quadrangulata, *F. v. M.* "Yucca" is the name on Kangaroo Island for Xanthorrhœa, hence Yucca Gum, which is an article of export.

GRAMINEÆ—* Hordeum murinum, *L.* (T) Spinifex hirsutus, *Labill.*

CAPE COUEDIE (R. S. ROGERS).

CRUCIFERÆ—(T) Lepidium foliosum, *Desv.*

FRANKENIACEÆ—(T) Frankenia pauciflora, *DC.* (lævis, *Tate*).

ZYGOPHYLLACEÆ—Nitraria Schoberi, *L.*: Zygophyllum Billardieri, *DC.*

RUTACEÆ—(T) Correa speciosa, *Ait.*

RHAMNACEÆ—(T) Spyridium vexilliferum, *Reiss.*

SAPINDACEÆ—Dodonæa humilis, *Endl.*

LEGUMINOSÆ—Eutaxia empetrifolia, *Schl.* (T) Lotus australis, *Andr.* Leaves succulent.

MYRTACEÆ—(T) Melaleuca gibbosa, *Labill;* Melaleuca parviflora, *Lindl.*

AIZOACEÆ—(T) Mesembryanthemum australe, *Sol.*

COMPOSITÆ—(T) Calocephalus Brownii, *F. v. M.;* Ixodia achilleoides, *R. Br.;* Podolepis rugata, *Labill.* (T) Senecio lautus, *Forst.* Very succulent.

GOODENIACEÆ—(T) Goodenia ovata, *Sm.* Coriaceous form, yellow-and-green leaves. (T) Scaevola crassifolia, *Labill.*

CAMPANULACEÆ—(T) Lobelia microsperma, *F. v. M.*

GENTIANACEÆ—(T) Sebæa ovata, *R. Br.*

SCROPHULARIACEÆ—Buechnera (?) linearis, *R. Br.* In fruit only. Doubtful in absence of flowers.

LAURACEÆ—(T) Cassytha pubescens, *R. Br.*

THYMELÆACEÆ—(T) Pimelea glauca, *R. Br.* Apparently a new record for the island.

GRAMINEÆ—(T) Poa cæspitosa, *Forst.*

CAPE BORDA (DR. R. S ROGERS).

DILLENIACEÆ—(T) Hibbertia stricta, *R. Br.*

TREMANDRACEÆ—Tetratheca thymifolia, *Sm.*

OLACACEÆ—Olax Benthamiana, *Miq.*

STACKHOUSIACEÆ—(T) Stackhousia monogyna, *Labill.*

RHAMNACEÆ—(T) Spiridium vexilliferum, *Reiss.*

LEGUMINOSÆ—Dillwynia hispida, *Lindl.*

HALORRHAGIDACEÆ—(T) Halorrhagis teucrioides, *A. Gray.*

MYRTACEÆ—(T) Calythrix tetragona, *Labill.*

COMPOSITÆ—(T) Ixiolæna supina, *F. v. M.;* Ixodia achilleoides, *R. Br.* A very distinct form with *narrow linear* almost filiform leaves. Bentham describes the leaves as "linear, lanceolate, or slightly spathulate." Olearia teretifolia, *F. v. M.*

GOODENIACEÆ—(T) Goodenia amplexans, *F. v. M.* (T) Scævola æmula, *R. Br.*

EPACRIDACEÆ—Astroloma conostephioides, *F. v. M.*

LABIATÆ—Prostanthera spinosa, *F. v. M.*

POLYGONACEÆ—(T) Muehlenbeckia adpressa, *Meissn.*

THYMELÆACEÆ—(T) Pimelea glauca, *R. Br.*

ORCHIDACEÆ—(T) Caladenia latifolia, *R. Br.* (T) Caladenia Patersoni, *R. Br.*

GRAMINEÆ—(T) Stipa semibarbata, *R. Br.*

Grevillea Rogersi, *nova species*.—In capite Borda, insula Kangaroo Island, in solo arenoso crescens.

Frutex humilis intricate ramosus. Folia in brevissimis lateralibus ramulis conferta, similia fasciculo 4-5 mm. longa, angusto-lanceolata dense revolutis marginibus, sæpe curvata, duræ texturæ et dense tecta brevibus et conicis asperitatibus subtus lanata. Flores solitarii, vel in umbellis paucissimis floribus in brevibus foliosis lateralibus ramulis; pedicelli circiter 7-8 mm. longa. Corollæ tubus 12-13 mm. longus, pars inferior leviter dilatata, glaber in exteriore parte, intus inferne barbatus ad fundum puniceus, obtusi et revoluti lobuli subflavi. Torus obliquus. Hypogyna glandula semi-annulata. Ovarium dense villosum, breviter stipulatum. Styla erecta quum flores decidissent, circiter $2\frac{1}{4}$ cm. longa; stigma lateralis.

A low, dense, intricately-branched shrub about 18 to 30 in. high as seen, with terete rather thick branches covered when young with crisp white hairs. *Leaves* densely crowded on very short lateral shoots so as to appear clustered, rarely alternate, and more distant on some elongated shoots, 4 to 5 mm. long, narrow-lanceolate, acute, with margins so closely revolute that the under-side is mostly concealed, often curved, of hard texture and densely covered on the upper side with short conical asperities; woolly-hairy on the under-side. *Flowers* solitary, in pairs or in very few-flowered umbels, terminal on the short lateral shoots, the pedicels slender, about 7 to 8 mm. long, sparingly hairy. *Corolla-tube* 12 to 13 mm. long, the lower part slightly dilated, pink to scarlet, 6-veined, glabrous outside, with a tuft of hairs inside near the base, the upper part of the tube with the short obtuse lobes revolute and of yellowish colour. *Torus* oblique. *Hypogynous gland* semi-annular. *Ovary* densely villous, shortly stipitate. *Style* straight after flowering, about $2\frac{1}{4}$ cm. long, sparingly hairy in the lower half; stigmatic disk lateral. *Fruit* ovate-oblong, about 13 mm. long, glabrous when old. *Seed* scarcely winged.

This interesting new species belongs to Section iii., Plagiopoda, but is not closely allied to any described species known to me. The peculiar clustered, hard and rough leaves are unique in the genus; they remind somewhat of the leaves of *Dendrobium cucumerinum*. It seems strange that such a remarkable species should have remained undiscovered until now, but Dr. Rogers writes that this part of Kangaroo Island has been little visited by collectors on account of the difficulty of reaching the place by water or by land. Dedicated to Richard Sanders Rogers, M.A., M.S., M.D. (Edin.),

Honorary Physician to the Adelaide Hospital, etc., the leading authority on South Australian Orchids. He collected this species at Cape Borda.

The Tasmanian Element in the Kangaroo Island Flora.

Tate (1) deals with this matter so far as certain species, which he enumerates as not known in any other part of South Australia, are concerned. In the same paper he deals further with the Tasmanian element, and adds: —

> The number of its (Kangaroo Island) peculiar species and those of Tasmanian origin entitle it to a subregional rank.

He further states: —

> The absence of a large number of species, alien and endemic, widely spread over the continent would seem to imply isolation before immigration of the extra-Australian species and those endemic ones of marked exotic genera to the shores of the adjacent mainland. The isolation was, without doubt, subsequent to that of Tasmania, though prior to the advent of man in Australia, botanical isolation being secured against man's aggression by reason of his inability to cross the Straits.

He also states that of 348 Australian species inhabiting Kangaroo Island, 203 occur in Tasmania.

I have not time to bring these figures up to date, but will only point out that enumeration of the few species (precisely 100) collected by Dr. Rogers and me in Kangaroo Island from four localities, gives us 67 Tasmanian species. Species collected at more than one of the four localities have, in these figures, been enumerated more than once.

Tate further says that Kangaroo Island is the meeting-ground of Tasmanian and Western Australian species. At Proc. R.S.S.A., xiii., 119, he shows the affinity of Kangaroo Island plants and those of South Eyre Peninsula, and observations in these two directions might well occupy the attention of a young South Australian botanist now that enumeration of the floras is better defined than when Tate first made his statements.

Tepper's paper, "Discovery of Tasmanian Plants near Adelaide" (Journ. Linn. Soc., xx., 72), may be referred to.

I have drawn attention to alien species by asterisks; compare Tate (1).

Port Augusta.

Malvaceæ—Sida corrugata, *Lindl.*

Zygophyllaceæ—Nitraria Schoberi, *L.* Fruits purple when ripe and saline to taste.

Sapindaceæ — Dodonæa viscosa, *L.*, var. attenuata, *F. v. M.* Twenty feet high, and with stem diameter of 6 in.

Leguminosæ—Cassia eremophila, *A. Cunn.*, var. platypoda, *Benth.* 3 to 4 ft. high. Cassia Sturtii, *R. Br.*, var.

coriacea, *Benth.* 3 to 4 ft. high. Templetonia egena, *Benth.*

AIZOACEÆ—Mesembryanthemum æquilaterale, *Haw.;* Mesembryanthemum crystallinum, *L.*

LORANTHACEÆ—Loranthus sp. on Acacia salicina, and on Exocarpus aphylla. This seems to belong to the section of Loranthus with the petals united to the middle, and with adnate anthers. In that case it may be Loranthus angustifolius, *R. Br.*, a South Australian species not in the Herbarium. Open flowers are required to determine the species with certainty.

GOODENIACEÆ—Scævola collaris, *F. v. M.*

BORRAGINACEÆ—Heliotropium europæum, *L.*

SOLANACEÆ—Solanum nigrum, *L.*

MYOPORACEÆ—Eremophila scoparia, *F. v. M.* With purple flowers and 6 to 7 ft. high.

CHENOPODIACEÆ—Atriplex angulatum, *Benth.;* Atriplex holocarpum, *F. v. M.* Bassia diacantha, *F. v. M.* With nearly always a third small spine on the fruits. Kochia brevifolia, *R. Br.;* Kochia oppositifolia, *Benth.;* Salsola Kali, *L.*

NYCTAGINACEÆ—Boerhaavia diffusa, *L.*

THYMELÆACEÆ—Pimelea microcephala, *R. Br.*

EUPHORBIACEÆ—Phyllanthus Fuernrohrii, *F. v. M.*

CASUARINACEÆ—Casuarina glauca, *Sieb.* Some were planted; I am uncertain whether all were planted. Casuarina stricta, *Ait.*

SANTALACEÆ—Exocarpus aphylla, *R. Br.*

GRAMINEÆ—Cynodon dactylon, *L. C. Rich.;* Eragrostis falcata, *Gaud.;* Stipa setacea, *R. Br.*

Murray Bridge.

My friend Mr. R. H. Cambage, of Sydney, accompanied me to the locality, and we took the opportunity of examining the flora and comparing notes, and a list of our finds is referred to below.

DILLENIACEÆ—Hibbertia stricta, *R. Br.*

CRUCIFERÆ—* Diplotaxis tenuifolia, *DC.* See also page 268. The commonest local weed.

PITTOSPORACEÆ—Billardiera cymosa, *F. v. M.;* Bursaria spinosa, *Cav.*

MALVACEÆ—* Malva rotundifolia *L.*

STERCULIACEÆ—Lasiopetalum Baueri, *Steetz.*

RUTACEÆ—Boronia cœrulescens, *F. v. M.*

RHAMNACEÆ—Stenanthemum leucophractum, *Reiss.*

SAPINDACEÆ—Dodonæa hexandra, *F. v. M.;* Dodonæa viscosa, *L.*, var. cuneata, *F. v. M.*

LEGUMINOSÆ—Cassia eremophila, *A. Cunn.*, var. platypoda; Cassia eremophila, *A. Cunn.*, var. zygophylla; Daviesia

genistifolia, *A. Cunn.* Leaves hardly articulate on the branches. Daviesia ulicina, *Sm.*, var. ruscifolia.

MYRTACEÆ—Baeckia Behrii, *F. v. M.*; Leptospermum lævigatum, *F. v. M.*; Melaleuca acuminata. We have two dense shrubs, one with bright-green leaves, comparatively broad. This is M. acuminata. It is mallee-like, and forms a dense shrub of 5-6 ft. Only fruits available. A second species which might casually be confused with it, has slightly broader and less curved leaves. Size and habit about same. Of a paler green. I refer this doubtfully to M. parviflora. I have not seen flowers. We have straight-, curved-, and broad-leaved Melaleucas at Murray Bridge, showing how impossible it is to maintain M. curvifolia, *Schl.*, as a species. These Melaleucas should be further examined.

ŒNOTHERACEÆ—* Œnothera biennis, *L.*

RUBIACEÆ—Opercularia hispida, *Sm.* (See also Hog Bay, Kangaroo Island.)

COMPOSITÆ—Athrixia tenella, *Benth.*; Cotula australis, *Hook.*; * Hedypnois cretica, *Willd.*; Helichrysum apiculatum, *DC.*; Olearia glandulosa, *Labill.*; Olearia lepidophylla, *Benth.*; Vittadinia australis, *A. Rich.* (2 forms).

GOODENIACEÆ—Goodenia geniculata, *R. Br.*; Goodenia lanata, *R. Br.*; Goodenia varia, *R. Br.* (with long, weak branches); Velleya paradoxa, *R. Br.*

CAMPANULACEÆ—Lobelia microsperma, *F. v. M.*

EPACRIDACEÆ—Leucopogon cordifolius, *Lindl.*

BORRAGINACEÆ—Halgania cyanea, *Lindl.*

MYOPORACEÆ—Eremophila Brownii, *F. v. M.*; Myoporum platycarpum, *R. Br.* A medium-sized tree.

LABIATÆ—Prostanthera coccinea, *F. v. M.*; Westringia rigida, *R. Br.*

CHENOPODIACEÆ—Atriplex Muelleri, *Benth.* With large leaves. Enchylæna tomentosa, *R. Br.*

LAURACEÆ—Cassytha melantha, *R. Br.*

PROTEACEÆ—Hakea ulicina, *R. Br.*

THYMELÆACEÆ—Pimelea curviflora, *R. Br.*; Pimelea serpyllifolia, *R. Br.*

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*; Euphorbia Drummondii, *Boiss.*

SANTALACEÆ—Exocarpus spartea, *R. Br.*; Fusanus acuminatus, *DC.*

CONIFERÆ—Callitris propinqua, *R. Br.* This handsome Cypress Pine has often much the habit of a Pinus, say of an Aleppo Pine. It has not a pointed top in large trees, and is of spreading habit. There are trees with trunks 3 ft. in diameter, but not proportionately tall. Foliage dark-coloured, not glaucous. Would be called a Black Pine. I believe I saw the same species at Quorn and other places

from a railway carriage. For further particulars concerning this not well-known species, see my "Forest Flora of New South Wales," part xii., p. 54. It should be extensively cultivated for timber, and shelter purposes in dry country.

LILIACEÆ—Arthropodium paniculatum, *R. Br.;* Tricoryne elatior, *R. Br.*

CYPERACEÆ—Gahnia deusta, *Benth.*

GRAMINEÆ—Amphipogon strictus, *R. Br.;* Festuca rigida, *Mert.* and *Koch.;* Panicum Mitchelli, *Benth.* Small form. Pappophorum commune, *F. v. M.;* Stipa pubescens, *R. Br.;* Stipa scabra, *Lindl.*

Fowler Bay (121).[2]

The specimens from Fowler Bay were partly collected by Dr. R. S. Rogers, and partly communicated by that gentleman on behalf of Mrs. Tom Brown, of Nullarbor Station.

PAPAVERACEÆ—* Papaver hybridum, *L.* Introduced from Europe.

CRUCIFERÆ — Capsella cochlearia, *F. v. M.*, var. ochrantha, *F. v. M.* (Thlaspi ochranthum, *F. v. M.*); Capsella elliptica, *Mey.;* Lepidium rotundum, *DC.;* Stenopetalum lineare, *R. Br.*

POLYGALACEÆ—Comesperma volubile, *Labill.*

FRANKENIACEÆ—Frankenia pauciflora, *DC.*

MALVACEÆ—* Malva parviflora, *L.* Introduced from Europe. Plagianthus microphyllus, *F. v. M.:* Plagianthus spicatus, *Benth.*

ZYGOPHYLLACEÆ — Zygophyllum ammophilum, *F. v. M.* (?) Determination doubtful. It differs from the type by the greater number of stamens. It is either a form of Zygophyllum ammophilum or a new species. More material required. Zygophyllum apiculatum, *F. v. M.;* Zygophyllum Billardieri, *DC.* Also a small-fruited form,(?) but no flowers available. Zygophyllum fruticulosum, *DC.*, var. bilobum.

GERANIACEÆ—* Erodium cicutarium, *L'Hér.* Introduced from Europe. * Oxalis corniculata, *L.*

RUTACEÆ—Geijera parviflora, *Lindl.*

SAPINDACEÆ—Dodonæa stenozyga, *F. v. M.*

LEGUMINOSÆ—Cassia eremophila, *A. Cunn.:* Swainsona lessertiifolia, *DC.;* Templetonia retusa, *R. Br.*

MYRTACEÆ—Melaleuca pustulata, *Hook.*

AIZOACEÆ—Aizoon zygophylloides, *F. v. M.;* Tetragonia diptera, *F. v. M.*(?) Ripe fruits required to confirm the determination. New for South Australia if correctly determined. Tetragonia implexicoma, *Hook.*

[2] The numbers given after the localities are the pages in the "Australia Directory," vol. i., 9th edition, 1897, where a description of each locality will be found. They are in regular sequence.

Umbelliferæ—Daucus brachiatus, *Sieb.*

Rubiaceæ—Galium umbrosum, *Sol.*

Compositæ—Brachycome pachyptera, *Turcz.*; Brachycome ciliaris, *Less.*; Calotis cymbacantha, *F. v. M.*; Calotis hispidula, *F. v. M.*; Helipterum Haigii, *F. v. M.*; Helipterum incanum, *DC.*; Olearia exiguifolia, *F. v. M.*; Olearia glutinosa, *Benth.*; Olearia Muelleri, *Sond.*; Podolepis rugata, *Labill.* (flower-heads usually small); Senecio lautus, *Forst.*; Senecio vulgaris, *L.*

Goodeniaceæ—Goodenia pinnatifida, *Schl.*; Velleia paradoxa, *R. Br.*

Borraginaceæ—Echinospermum concavum, *F. v. M.*

Solanaceæ—Solanum aviculare, *Forst.*

Myoporaceæ—Eremophila Brownii, *F. v. M.* (form with white tomentose leaves); Myoporum insulare, *R. Br.*

Labiatæ—Teucrium sessiliflorum, *Benth.*; Westringia rigida, *R. Br.*

Plantaginaceæ—Plantago varia, *R. Br.*

Chenopodiaceæ—Atriplex vesicarium, *Hew.*; Chenopodium Preissii, *Diels* (in fragments only, and therefore doubtful); Kochia ciliata, *F. v. M.*; Kochia pentatropis, *Tate*; Kochia sedifolia, *F. v. M.*; Kochia villosa, *Lindl.*; Rhagodia crassifolia, *R. Br.*

Amarantaceæ—Ptilotus obovatus, *F. v. M.*

Thymelæaceæ—Pimelea curviflora, *R. Br.*

Urticaceæ—Parietaria debilis, *Forst.*

Liliaceæ—Arthropodium minus, *R. Br.*; Wurmbea dioica, *F. v. M.*

Gramineæ—Danthonia penicillata, *F. v. M.*; Poa nodosa, *Nees.*; Stipa scabra, *Lindl.*

Sinclair Point (LeHunte Bay). (123)

Sinclair Point is sixteen miles from Eyre Bluff.

Cruciferæ—Sisymbrium orientale, *L.*

Frankeniaceæ—Frankenia pauciflora, *DC.*

Zygophyllaceæ—Zygophyllum Billardieri, *DC.*

Compositæ — Helipterum incanum, *DC.*; Ixiolæna tomentosa, *Sond.* and *F. v. M.*; Senecio lautus, *Forst.*

Goodeniaceæ—Scævola crassifolia, *Labill.*

Solanaceæ—Nicotiana suaveolens, *Lehm.*; Solanum hystrix, *R. Br.*

Labiatæ—Westringia Dampieri, *R. Br.*

Chenopodiaceæ—Kochia villosa, *Lindl.*

Davenport River (131).

Davenport is a mangrove creek on the southern side of Tourville Bay, which is itself on the north-western part of Denial Bay.

Zygophyllaceæ—Zygophyllum Billardieri, *DC.*

Leguminosæ—Templetonia retusa, *R. Br.*
Compositæ—Helipterum incanum, *DC.*
Primulaceæ—Samolus repens, *Pers.*
Verbenaceæ—Avicennia officinalis, *L.* (Mangrove).
Chenopodiaceæ—Rhagodia crassifolia, *R. Br.*
Santalaceæ—Santalum sp.

Murat and Denial Bays (132).

Murat Bay is the north part of Denial Bay.

Polygalaceæ—Comesperma volubile, *Labill.*

Rutaceæ—Geijera parviflora, *Lindl.;* Microcybe pauciflora, *Turcz.* (Eriostemon capitatus, *F. v. M.*).

Myrtaceæ—Melaleuca pustulata, *Hook.*, and a narrow-leaved Loranthus (without flowers) on it.

Compositæ—Brachycome trachycarpa, *F. v. M.;* Olearia Muelleri, *Sond.*

Labiatæ—Westringia rigida, *R. Br.*

Chenopodiaceæ—Atriplex paludosa, *R. Br.* (?); not in fruit.

Laura Bay (135).

Polygalaceæ—Comesperma volubile, *Labill.*

Compositæ—Brachycome pachyptera, *Turcz.;* Ixiolæna tomentosa, *Sond.* and *F. v. M.;* Leptorrhynchos Waitzia, *Sond.*

Labiatæ—Westringia Dampieri, *R. Br.*

Chenopodiaceæ—Atriplex paludosa, *R. Br.*

Euphorbiaceæ—Beyeria viscosa, *Miq.*

Gramineæ—Danthonia penicillata, *F. v. M.;* Poa nodosa, *Nees.;* Stipa pubescens, *R. Br.*

Streaky Bay (141).

Geraniaceæ—* Erodium cicutarium, *L'Hér.;* * Oxalis corniculata, *L.*

Rutaceæ—Geijera parviflora, *Lindl.*

Leguminosæ—* Melilotus parviflorus, *Desf.*

Compositæ—Athrixia tenella, *Benth.;* Erigeron pappochromus, *Labill.;* Helichrysum apiculatum, *DC.;* Olearia glutinosa, *Benth.*

Goodeniaceæ—Goodenia pinnatifida, *Schl.;* Goodenia sp. Near the narrow-leaved form of G. elongata.

Campanulaceæ—Wahlenbergia gracilis, *DC.*

Labiatæ—Teucrium sessiliflorum, *Benth.*

Amarantaceæ—Trichinium spathulatum, *R. Br.*

Venus Harbour (146).

Polygalaceæ—Comesperma volubile, *Labill.*

Sterculiaceæ—Lasiopetalum discolor, *Hook.*

Zygophyllaceæ—Nitraria Schoberi, *L.*
Geraniaceæ—Erodium cicutarium, *L'Hér.*
Crassulaceæ—Tillæa verticillaris, *DC.*
Myrtaceæ—Melaleuca acuminata, *F. v. M.;* Melaleuca parviflora, *Lindl.*
Compositæ—Leptorrhynchos Waitzia, *Sond.;* Podotheca angustifolia, *Less.;* Senecio lautus, *Forst.*
Primulaceæ—* Anagallis arvensis, *L.;* Samolus repens, *Pers.*
Borraginaceæ—Echinospermum concavum, *F. v. M.*
Myoporaceæ—Myoporum insulare, *R. Br.*
Verbenaceæ—Avicennia officinalis, *L.*
Chenopodiaceæ—Atriplex cinera, *Poir.*
Amarantaceæ—Trichinium spathulatum, *R. Br.*
Liliaceæ—Bulbine semibarbata, *Haw.*
Gramineæ—Distichlis maritima, *Rafin.;* Poa cæspitosa, *Forst.*

Flinders Island (148).

The largest and central island of the Investigator group.
Ranunculaceæ—Clematis microphylla, *DC.*
Zygophyllaceæ—Zygophyllum Billardieri, *DC.*
Leguminosæ—* Medicago denticulata, *Willd.;* * Melilotus parviflorus, *Desf.;* Swainsona sp.; Templetonia retusa, *R. Br.*
Myrtaceæ—Calythrix tetragona, *Labill.*
Aizoaceæ—Tetragonia implexicoma, *Hook.*
Compositæ—Senecio lautus, *Forst.*
Epacridaceæ—Leucopogon Richei, *R. Br.*
Myoporaceæ—Myoporum insulare, *R. Br.*
Labiatæ—Westringia Dampieri, *R. Br.*
Gramineæ—* Hordeum murinum, *L.*

Port Elliston (151).

On the east side of Waterloo Bay.
Polygalaceæ—Comesperma volubile, *Labill.*
Malvaceæ—Hibiscus Wrayæ, *Lindl.*
Portulacaceæ—Calandrinia calyptrata, *Hook.*
Geraniaceæ—* Erodium cicutarium, *L'Hér.*
Stackhousiaceæ—Stackhousia monogyna, *Labill.*
Leguminosæ—Eutaxia empetrifolia, *Schl.;* Lotus australis, *Andr.*
Myrtaceæ—Malaleuca pustulata, *Hook.*
Compositæ—Erigeron pappochromus, *Labill.:* Helichrysum apiculatum, *DC.;* Helipterum incanum, *DC.;* Podotheca angustifolia, *Less.;* Senecio lautus, *Forst.*
Goodeniaceæ—Goodenia geniculata, *R. Br.;* Scævola crassifolia, *Labill.*

PRIMULACEÆ—* Anagallis arvensis, *L.*
MYOPORACEÆ—Myoporum humile, *R. Br.*
LABIATÆ—Westringia Dampieri, *R. Br.*
EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*
GRAMINEÆ—Poa cæspitosa, *Forst.*

Williams Island (168).

A gentle, undulating island, and covered with a dense mass of hummocky bushes about 2 ft. high. The foliage is almost entirely glaucous. Grasses almost absent. No trees or grazing animals on the island. There are a few snakes; these animals were very rare in the places we visited.

CRUCIFERÆ—Lepidium foliosum, *Desv.*
FRANKENIACEÆ—Frankenia pauciflora, *DC.*
ZYGOPHYLLACEÆ—Nitraria Schoberi, *L.*
AIZOACEÆ—Mesembryanthemum æquilaterale, *Haw.*, but the section scarcely triangular.
UMBELLIFERÆ—Apium leptophyllum, *F. v. M.*
CHENOPODIACEÆ—Atriplex (?) campanulata, *Benth.* Very common. Rhagodia (crimson fruit). A sea of Atriplex cinerea, *Poir.*
GRAMINEÆ—Bromus arenarius, *Labill.* Two feet high.

Neptune Isles.

Named by Flinders, February 21, 1802, "for they seemed inaccessible to men." They consist of the North and South Neptunes. We landed on that South Neptune Island (there are two) on which is the lighthouse. It is about two miles round and about 120 ft. high.

SOUTH NEPTUNE (169).

This has some interest as a granite flora. The vegetation is very hummocky and intensely succulent and saline. Nothing higher than 2-3 ft. There are very few species. There is a large number of big goats on the island, and these animals have already changed the vegetation.

CRUCIFERÆ—Lepidium foliosum, *Desv.*
FRANKENIACEÆ—Frankenia pauciflora, *DC.*, with pleasing, purple-pink flowers; very common.
CARYOPHYLLACEÆ—Spergula marina, *Bartl.* and *Wendl.*; Spergularia rubra, *Cambess.*
MALVACEÆ—Lavatera plebeja, *Sims.* "Marshmallow." Almost extinct owing to the goats. Also a Malva or Modiola in leaf only. Everywhere eaten down.
ZYGOPHYLLACEÆ—Nitraria Schoberi, *L.* A dense shrub with fleshy spathulate leaves, oval- or egg-shaped fruits $\frac{1}{2}$ in., brownish purple when ripe. Fleshy pericarp.

AIZOACEÆ—Mesembryanthemum æquilaterale, *Haw.*, in full fruit; crimson. You squeeze out the seedy pulp, which has a peculiar flavour, partly saline, and with not too pleasant an odour. It is sweetish, and some people say they like it. The blacks on the mainland are very fond of it.

UMBELLIFERÆ—Apium australe, *Thou.* (leptophyllum); * Conium maculatum, *L.* The Poison Hemlock! (*Dr. Rogers.*)

COMPOSITÆ—Cotula australis, *Hook.:* Cotula coronopifolia, *L.* (occurs wherever there is a spring of fresh water); Senecio lautus, *Forst.;* Sonchus oleraceus, *L.*

CHENOPODIACEÆ—Atriplex cinerea, *Poir.*, locally called "Blue Bush." Atriplex Muelleri, *Benth.;* Enchylæna tomentosa, *R. Br.;* Salicornia australis, *Sol.*

GRAMINEÆ—Distichlis maritima, *Rafin.* There is only one other grass not in flower. It is said that rabbits ate out the grass.

Wedge Island (170).

is one of the Gambier Isles, is three miles long, and has an average width of one mile. The "Australia Directory" says that it is principally formed of limestone, is covered with low bushes and Camarina trees, and a little grass, and has been used as a sheep-run.

CRUCIFERÆ—Cakile maritima, *Scopoli.*

RHAMNACEÆ—Spyridium vexilliferum, *Reiss.*

LEGUMINOSÆ—Pultenæa rigida, *R. Br.* Not in flower, but typical.

COMPOSITÆ—Helichrysum leucopsidium, *DC.;* Ixodia achilleoides, *R. Br.;* Senecio lautus, *Forst.*

GOODENIACEÆ—Goodenia ovata, *Sm.*

CHENOPODIACEÆ—Atriplex cinerea, *Poir.*

SANTALACEÆ—Exocarpus stricta, *R. Br.*

CYPERACEÆ—Scirpus nodosus, *Rottb.*

Thistle Island (173).

Named by Flinders February 21, 1802, after the master of the "Investigator." Here the eagles, as Flinders supposes, mistook the men for kangaroos, and swooped at first. It is nine miles long and rises to a height of 772 ft. in the centre. The "Australian Directory" says:—"Thistle Island has from time to time been used as a sheep- and cattle-run, but has not been found hitherto to answer, owing, it is stated, to the cattle and sheep eating some poisonous herb which grows on the island; otherwise it appears very fit for grazing purposes." At present it is used for grazing and cultivation, and I could not find any plant which could be

looked upon as a poison plant. We landed at Whalers' Bay, where there was a large area under barley. Fennel very abundant; acres of it.

CRUCIFERÆ—Cakile maritima, *Scopoli.*

STERCULIACEÆ—Lasiopetalum discolor, *Hook.* Four feet high, in full bloom, pink flowers, and forming a very handsome shrub. It is surely a very desirable plant for gardens in marine situations.

GERANIACEÆ—Pelargonium australe, *Willd.*

RHAMNACEÆ—Spyridium vexilliferum, *Reiss.*

COMPOSITÆ—Brachycome ciliaris, *Less.* A very small-flowered form. Disc achenes winged: achenes of the ligulate flowers with rough sides and without wings. Calocephalus Brownii, *F. v. M.;* Centaurea melitensis, *L.* Very plentiful. Helichrysum apiculatum, *DC.;* Helichrysum leucopsidium, *DC.;* Ixodia achilleoides, *R. Br.;* Olearia lepidophylla, *Benth.:* Picris hieracioides, *L.;* Podolepis rugata, *Labill.;* Senecio lautus, *Forst.:* Sonchus oleraceus, *L.*, var, asper.

GOODENIACEÆ—Goodenia ovata, *Sm.* Coriaceous form, very broad, yellow-green leaves (near G. varia).

MYOPORACEÆ—Myoporum insulare, *R. Br.;* Myoporum humile, *R. Br.* Very lovely dwarf-spreading bush, a blaze of white flowers.

CHENOPODIACEÆ—Chenopodium microphyllum, *F. v. M.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*

CASUARINACEÆ—The island is lightly timbered with Casuarina stricta, *Ait.*

SANTALACEÆ—Exocarpus stricta, *R. Br.*

CYPERACEÆ—Lepidosperma gladiata, *Labill.;* Scirpus nodosus, *Rottb.*

GRAMINEÆ—Bromus sp.

Memory Cove (178).

PITTOSPORACEÆ—Pittosporum phillyræoides, *DC.* (with rigid leaves).

STERCULIACEÆ—Lasiopetalum discolor, *Hook.*

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*

MYRTACEÆ—Melaleuca parviflora, *Lindl.*

AIZOACEÆ—Mesembryanthemum australe, *Sol.*

EPACRIDACEÆ—Acrotriche patula, *R. Br.*

LABIATÆ—Westringia Dampieri, *R. Br.* These specimens have three leaves in a whorl like W. rigida, but with the long leaves of W. Dampieri. There is really no difference between the two species. See Bentham's note, B. Fl., v. 129. W. rigida should be merged in W. Dampieri, the latter being

technically the older name, since in the original descriptions of both (R. Br., Prod. 501) W. Dampieri comes first in sequence.

THYMELÆACEÆ—Pimelea sp. A large, bushy species without flowers.

GRAMINEÆ—Poa cæspitosa, *Forst.*

Taylor Island (180).

Named by Flinders after the midshipman of the "Investigator" who lost his life near Cape Catastrophe. It is one and a half miles long and about half a mile broad. It is mostly covered with scrub; the south end is grassy ("Australia Directory").

RANUNCULACEÆ—Clematis microphylla, *DC.*

CRUCIFERÆ—Sisymbrium officinale, *Scop.*

MALVACEÆ—Lavatera plebeja, *Sims.*

COMPOSITÆ—Senecio lautus, *Forst.*

CHENOPODIACEÆ—Chenopodium nitrariaceum, *F. v. M.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

Cape Donington (182).

The north-east point of a headland, on the south-east side of the entrance to Port Lincoln.

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*, var. bilobum.

RUTACEÆ—Geijera parviflora, *Lindl.*

UMBELLIFERÆ—Didiscus pilosus, *Benth.*

APOCYNACEÆ—Alyxia buxifolia, *R. Br.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

THYMELÆACEÆ—Pimelea flava, *R. Br.*

Port Lincoln (182).

DILLENIACEÆ—Hibbertia Billardieri, *F. v. M.* Two and a half miles along the old Western Road. A tall, floriferous, very beautiful form.

CRUCIFERÆ—* Diplotaxis tenuifolia, *DC.* The pest of Port Lincoln, a yellow-flowering plant, 1-2 ft. high, very bright and beautiful, and exceedingly abundant everywhere at Port Lincoln; a worthless Wild Mustard. Called outside "Port Lincoln Weed." See also J. M. Black in "Journ. Agric. S.A.," June, 1907, p. 687.

MALVACEÆ — Hibiscus Wrayæ, *Lindl.* Rich purple flowers; 4 ft. high.

STERCULIACEÆ—Lasiopetalum Baueri, *Steetz;* Lasiopetalum discolor, *Hook.*

RUTACEÆ—Correa speciosa, *Andr.* Stamford Hill.

Leguminosæ—Eutaxia empetrifolia, *Schl.* A prickly, uncomfortable shrub. Boston Island. Pultenæa vestita, *R. Br.*; Templetonia retusa, *R. Br.*; 6 ft. high.

Myrtaceæ—Calythrix tetragona, *Labill.*; Melaleuca decussata, *R. Br.*; Melaleuca parviflora, *Lindl.* Stamford Hill and Kirton Point. Some trees remarkably beautiful in shape. Melaleuca uncinata, *R. Br.* Boston Island, 6 in. diameter, 20 ft. high. Papery bark.

Aizoaceæ — Mesembryanthemum æquilaterale, *Haw.* (Even on summit of Stamford Hill.)

Compositæ—Helichrysum apiculatum, *DC.*; Ixodia achilleoides, *R. Br.* Stamford Hill; acres of it. Olearia ciliata, *F. v. M.*

Campanulaceæ—Wahlenbergia gracilis, *DC.*

Epacridaceæ—Acrotriche patula, *R. Br.*; Leucopogon cordifolius, *Lindl.*; Leucopogon Richei, *R. Br.*

Apocynaceæ—Alyxia buxifolia, *R. Br.*

Scrophulariaceæ—Veronica distans, *R. Br.* (Dr. Rogers).

Myoporaceæ—Myoporum viscosum, *R. Br.*

Chenopodiaceæ—Bassia (?) anisacantha. On seashore, 1 ft. high, and spreading. In leaf only. Boston Island.

Polygonaceæ—Muehlenbeckia adpressa, *Meissn.* Boston Island.

Lauraceæ—Cassytha glabella, *R. Br.*

Euphorbiaceæ—Beyeria viscosa, *Miq.*

Casuarinaceæ—Casuarina stricta, *Ait.* Boston Island.

Santalaceæ—Exocarpus aphylla, *R. Br.* Stamford Hill. Fusanus acuminatus, *DC.*; Leptomeria aphylla, *R. Br.*

Gramineæ—Distichlis maritima, *Rafin.*; Spinifex hirsutus, *Labill.*; Stipa scabra, *Lindl.* All from Boston Island.

The following trees are planted in the streets of Port Lincoln, and are doing well on the whole:—

Lagunaria Patersoni, *G. Don;* from Norfolk Island. Schinus molle, *L.*; Pepper. Callitris propinqua, *R. Br.*; the Cypress Pine, native of the district. Eucalyptus globulus, *Labill.*; a forest tree; seems to be too large for street-planting. Pinus halepensis, *Mill.*; does splendidly. Nicotiana glauca, *R. Grah.*; a small tree. Cupressus sempervirens, *L.* Moreton Bay Fig; not doing well. Pomegranate. Oleander.

Port Lincoln to North Shields.

Dilleniaceæ—Hibbertia sericea, *Benth.*

Hypericeæ—* Hypericum perforatum, *L.* A pretty yellow-flowered plant. A weed pest.

Cactaceæ — * Opuntia monocantha, *Haw.* Prickly Pear; not much of it along the road; apparently not a pest there, but there is plenty at North Shields. This is a plant which, however, requires watching, and, if necessary, dealing with by authority.

Compositæ—* Carduus lanceolatus, *L.* (the common Black or Scotch Thistle). Not rare. Humea cassiniacea, *F. v. M.* A squatty little plant, with the flowers sometimes solitary in the headlets. It appears to be uncommon. * Onopordon acanthium, *L.* (the Cottony or Scotch Heraldic Thistle). Not rare.

Goodeniaceæ—Goodenia ovata, *Sm.*

Epacridaceæ—Astroloma conostephioides, *F. v. M.*; Astroloma humifusum, *R. Br.*

Primulaceæ—Samolus repens, *Pers.*

Convolvulaceæ—Convolvulus erubescens, *Sims.*

Chenopodiaceæ—Enchylæna tomentosa, *R. Br.*

Amarantaceæ—Ptilotus, sp.

Proteaceæ—Hakea cycloptera, *R. Br.*

Liliaceæ—* Asphodelus fistulosus, *L.* An onion-like plant. A weed pest. Xanthorrhœa semiplana, *F. v. M.* Occurs 3-4 miles out.

Port Lincoln to Lake Wangary and Mount Dutton Bay.

Ranunculaceæ—Clematis microphylla, *DC.*

Dilleniaceæ—Hibbertia Billardieri, *F. v. M.* Remarkably fine, 4-5 ft. high, in shelter and very bushy. Hibbertia sericea, *Benth.*; Hibbertia stricta, *R. Br.*

Pittosporaceæ—Bursaria spinosa, *Cav.* Called Christmas-tree locally, because it usually flowers profusely at that period. Pittosporum phillyræoides, *DC.*, at 20 miles.

Malvaceæ—Hibiscus Wrayæ, *Lindl.* "Port Lincoln Rose." Up to 6 ft. high, and nipped by stock.

Sterculiaceæ—Lasiopetalum (?) Baueri, *Steetz*, not in flower; Lasiopetalum discolor, *Hook.*

Leguminosæ—Daviesia brevifolia, *Lindl.*; Hardenbergia monophylla, called "Purple Lilac" in the district; Pultenæa villifera, *Sieb.*, var. australis, *Benth.*

Rosaceæ—* Rubus rubiginosa, *P. J. Muell.* "Sweet Briar." At say 7 miles.

Halorrhagidaceæ—Halorrhagis digyna, *Labill.*, 2-3 ft. high at 19-20 miles.

Myrtaceæ—Bæckia Behrii, *F. v. M.* With shorter flower-stalks and shorter recurved point of the leaves, apparently also of less erect growth; 2-3 ft. high in clumps or

amongst Xanthorrhœa. Callistemon coccineus, *F. v. M.* Very abundant. Large long masses. Walls of it 6-8 ft. high. Melaleuca decussata, *R. Br.* Pink flowers. Melaleuca parviflora, *Lindl.* (curvifolia, *Schl.*). Everywhere. Called "Black Tea-tree" from its usual dark aspect. Fine rounded shapely trees giving the country a park-like aspect. Melaleuca pustulata, *Hook.* White flowers. Melaleuca uncinata, *R. Br.* Brooms made of the plant, hence the name "Broom-bush."

AIZOACEÆ—Mesembryanthemum crystallinum, *L.;* Tetragonia implexicoma, *Hook.*

CACTACEÆ—* Opuntia monocantha, *Haw.* At Little Swamp.

COMPOSITÆ—Athrixia tenella, *Benth.* * Inula graveolens, *Desf.* "Stinkwort." Very bad. * Onopordon Acanthium, *L.* Very plentiful at the edge of "Big Swamp." Senecio lautus, *Forst.* Vittadinia australis, *A. Rich.*

EPACRIDACEÆ—Astroloma humifusa, *R. Br.;* Leucopogon Richei, *R. Br.;* Lissanthe strigosa, *R. Br.*

BORRAGINACEÆ — Echium plantagineum, *L.* See "Agric. Gaz. N.S.W.," March, 1905. Halgania cyanea, *Lindl.*

SOLANACEÆ—Nicotiana suaveolens, *Lehm.*

MYOPORACEÆ—Myoporum humile, *R. Br.* Sweet-scented flowers.

CHENOPODIACEÆ—Atriplex cinera, *Poir.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.* Called "Sarsaparilla."

PROTEACEÆ—Adenanthos terminalis, *R. Br.* Yellow-flowered, prostrate shrub up to 2 ft. high. Wangary and along the road, 18-19 miles out. Banksia æmula, *R. Br.* Wanilla Forest Reserve. Very handsome. Banksia marginata, *Cav.*, 6-8 ft. high. Grevillea ilicifolia, *R. Br.* "Holly bush," 2-3 ft. high. Greenish-white flowers. At 16 miles. Hakea cycloptera, *R. Br.* Large fruit. Appears local in Port Lincoln district. Hakea rostrata, *F. v. M.*

THYMELÆACEÆ—Pimelea glauca, *R. Br.* In swampy land.

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*

CASUARINACEÆ—Casuarina stricta, *Ait.*

SANTALACEÆ—Exocarpus cupressiformis, *Labill.*

CONIFERÆ—Callitris propinqua, *R. Br.* Not common.

LILIACEÆ—Thysanotus. Very beautiful, 3 ft. high in clumps of Xanthorrhœa, but apparently not collected. Xanthorrhœe semiplana, *F. v. M.* Common.

TYPHACEÆ—Typha angustifolia, *L.*, in pond near Big Swamp.

Cyperaceæ—Chorizandra enodis, *Nees*. With small dark-coloured spherical heads. Gahnia trifida, *Labill*. At "Eating House" and other places. Known as "Thatching Grass." Black Grass and Thatching Grass often occur together. Mesomelæna deusta, *Benth*. Known as "Black Grass."

Gramineæ—Anthistiria ciliata, *L*. Triodia irritans, *R. Br*., 20-22 miles out.

Sir Joseph Banks Group

consists of twenty islands, islets, and rocks, in Spencer Gulf. Revesby and Spilsby are the only islands on which water is obtainable and where the vegetation is higher than low bushes ("Australia Directory," p. 193). We visited Revesby.

Revesby (197).

A sandy island for the most part, and with a very coarse-grained granite at the western end. It is three miles long. The tree vegetation seems to be all Myoporum insulare and Casuarina stricta. Of the latter only five remain alive now out of ten formerly said to be growing.

There are said to be only two mallee plants on the island, but I did not see them.

The ripe fruits of Posidonia australis, *Hook., f*., were especially abundant in Spencer Gulf, off and on the shores of Revesby Island, Port Lincoln, etc. Compare Tepper, these Proceedings, iv., 1-4 and 47-9; also Ascherson, *ib*. v. 37-9.

Frankeniaceæ—Frankenia pauciflora, *DC*.

Malvaceæ—Lavatera plebeja, *Sims*. "Marshmallow."

Zygophyllaceæ—Nitraria Schoberi, *L*. Very large plants.

Geraniaceæ—* Erodium cicutarium, *L'Hér*.

Aizoaceæ—Mesembryanthemum crystallinum, *L*.

Compositæ—Calocephalus Brownii, *F. v. M*., 2 ft. high and hummocky; Senecio lautus, *Forst*.

Myoporaceæ—Myoporum insulare, *R. Br*.

Chenopodiaceæ—Atriplex cinerea, *Poir.;* Atriplex paludosa, *R. Br.;* Enchylæna tomentosa, *R. Br*.

Polygonaceæ—Muehlenbeckia adpressa, *Meissn*. A small trailing plant, and also found on tallest shrubs.

Cyperaceæ—Scirpus nodosus, *Rottb*.

Gramineæ—Spinifex hirsutus, *Labill.;* Distichlis maritima, *Rafin.;* * Hordeum murinum, *L*.

Althorpes (216).

Althorpe Isles are three in number, the south and largest being four and a half miles from Cape Spencer and twenty-

six and a half miles from Cape Borda. "It is of an irregular shape, about six cables across, nearly flat-topped, and 305 ft. high" ("Australia Directory").

CRUCIFERÆ—Lepidium foliosum, *Desv.*

CARYOPHYLLACEÆ—Spergularia rubra, *Cambess.*

MALVACEÆ—Lavatera plebeja, *Sims;* * Malva parviflora, *L.*

LEGUMINOSÆ—Swainsona sp. (in leaf only).

UMBELLIFERÆ—Apium prostratum, *Labill.*

COMPOSITÆ—Podolepis acuminata, *R. Br.;* Senecio lautus, *Forst.*

Marion Bay, Investigator Strait (286).

DILLENIACEÆ—Hibbertia stricta, *R. Br.*

STACKHOUSIACEÆ—Stackhousia monogyna, *Labill.*

LEGUMINOSÆ—Kennedya prostrata, *R. Br.;* Pultenæa tenuifolia, *R. Br.*

COMPOSITÆ—Olearia ciliata, *F. v. M.;* Senecio lautus, *Forst.*

EPACRIDACEÆ—Leucopogon Richei, *R. Br.*

PRIMULACEÆ—* Anagallis arvensis, *L.*

LOGANIACEÆ—Logania ovata, *R. Br.*

SOLANACEÆ—Solanum simile, *F. v. M.*

SCROPHULARIACEÆ—Euphrasia Brownii, *F. v. M.*

MYOPORACEÆ—Myoporum insulare, *R. Br.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

THYMELÆACEÆ—Pimelea glauca, *R. Br.*

LILIACEÆ—Dianella revoluta, *R. Br.*

Port Moorowie, Yorke Peninsula (288).

Immediately east of Gilbert Point.

COMPOSITÆ—Athrixia tenella, *Benth.;* Leptorrhynchos squamatus, *Less.*

GOODENIACEÆ—Velleia paradoxa, *R. Br.*

MYOPORACEÆ—Eremophila crassifolia, *F. v. M.* The remarkable and prominent resinous glands on the branches are not mentioned in the description of this plant in the "Flora Australiensis." The specimens agree in other respects better with Mueller's plate in his "Myoporinous plants," but the description, "Corolla not twice as long as the calyx" (B. Fl., v., 11), does not agree either with the specimens or with Mueller's figure. Myoporum insulare, *R. Br.*

Cape Jervis (316).

This is a wind-swept cape. The soil is poor, and, to add to the troubles of a cultivator, there are rabbits galore. Many plants are viscid.

Ranunculaceæ—Clematis microphylla, *DC.*

Dilleniaceæ—Hibbertia stricta, *R. Br.*

Pittosporaceæ—Bursaria spinosa, *Cav.* Near the coast quite stunted, and clinging to the broken ground.

Sterculiaceæ—Thomasia petalocalyx, *F. v. M.* Near the sea are dense, eaten-down tussocks of 1 ft. high and several feet diameter. Further back the shrubs are 2-3 ft., and with their pink flowers and soft foliage form very beautiful plants well worthy of a place in gardens.

Rhamnaceæ—Spyridium sp.

Leguminosæ—Hardenbergia monophylla, *Benth.* Very broad leaves. Kennedya prostrata, *R. Br.*

Myrtaceæ—Melaleuca parviflora, *Lindl.* Fine spreading tree 2 ft. diameter, 30 ft. high.

Cucurbitaceæ—Cucumis myriocarpus, *Naud.*, or Melothria Muelleri, *Benth.* Probably the former. The two specimens are hardly distinguished in foliage, but the fruits are totally different.

Aizoaceæ—Mesembryanthemum æquilaterale, *Haw.*

Rubiaceæ—Galium umbrosum, *Sol.*

Compositæ—Calocephalus Brownii, *F. v. M.;* * Carduus marianus, *L.* Abundant. * Centaurea melitensis, *L.*, is abundant, as many other weed pests; Erechtites quadridentata, *DC.;* Helichrysum apiculatum, *DC.* Dwarf. Ixiolæna supina, *F. v. M.;* Olearia sp. Dense masses (small-leaved), 4 ft., not in flower.

Goodeniaceæ—Goodenia amplexans, *F. v. M.* Broad-leaved, viscid, stem-clasping, bushy, and spreading, 1 ft.-1 ft. 6 in. A very handsome plant for places where there is but little dust. Goodenia geniculata, *R. Br.* A dwarf plant, radical-leaved, and then runners. Scævola microcarpa, *Cav.*

Campanulaceæ—Wahlenbergia gracilis, *DC.*

Primulaceæ—* Anagallis arvensis, *L.*

Gentianaceæ—Erythræa australis, *R. Br.*

Solanaceæ—* Lycium australe, *F. v. M.* 3-4 ft. Fleshy-leaved.

Proteaceæ—Grevillea lavandulacea, *Schl.;* Hakea rostrata, *F. v. M.;* Hakea rugosa, *R. Br.*

Thymelæaceæ—Pimelea glauca, *R. Br.* Dwarf.

Casuarinaceæ—Casuarina distyla, *Vent.;* Casuarina stricta, *Ait.* One of the few large trees.

Liliaceæ — Arthropodium paniculatum, *R. Br.;* Xanthorrhœa. Not in flower.

Cyperaceæ—Gahnia lanigera, *Benth.* Forming tussocks. Lepidosperma gladiatum, *Labill.;* Lepidosperma laterale, *R. Br.* Forming tussocks.

Gramineæ—* Bromus madritensis, *L.;* Distichlis maritima, *Rafin;* * Hordeum murinum, *L.*

ACACIAS

(in alphabetical order).

A. acinacea, Lindl., 2-3 ft. Kirton Point, Port Lincoln.

A. anceps, R. Br. A coarse round-headed shrub, straggly, of 4-5 ft. high. Has large, sweet-scented flowers; seen growing on the limestone only. Point Kirton, Cape Donington, and Port Elliston (R. S. Rogers).

A. armata, R. Br. Hog Bay (Kangaroo Island), and various other places; very plentiful. Pods viscid, hairy.

A. brachybotrya, Benth. Murray Bridge.

A. calamifolia, Sweet. A tall bushy shrub in flower at Kirton Point; also at Port Lincoln in flower and fruit. Murray Bridge in young bud. At Lake Wangary only 2-3 ft. high. Marion Bay, Yorke Peninsula (R. S. Rogers).

A. dodonæfolia, Willd. A viscid, tall shrub or small tree. Hog Bay (Kangaroo Island), Boston Island, Stamford Hill, and Port Lincoln.

A. longifolia, Willd., Kirton Point. A tall, bushy shrub.

A. montana, Benth. Murray Bridge, neither in flower nor fruit.

A. myrtifolia, Willd. Aldgate.

A. notabilis, F. v. M. Fowler Bay (R. S. Rogers).

A. pycnantha, Benth. Hog Bay, 10-15 ft., glaucous, and affected with galls. Cape Couedie, Murray Bridge, Memory Cove.

A. retinodes, Schl. At Hog Bay (Kangaroo Island), and glaucous. At Aldgate, a medium-sized tree, with sweet-scented flowers, and flourishing in damp situations. The width of the phyllodes varies a good deal.

A. retinodes, Schl., var. *Gillii* (**new var.** Syn. *A. pycnantha, Benth.*, var. (?) *angustifolia*, Benth., *B. Fl.*, ii., 365), Port Lincoln to Marble Range (W. Gill, December, 1897). A thin, straggling, wiry shrub of 6 ft. or more, with divaricate angular branches and coriaceous phyllodia, spreading often in a right angle or even reflexed. *Young branches very angular, flexuous, frequently in a regular zigzag line.* Flower-heads solitary on axillary, rather long peduncles, or racemose by suppression of the leaves, and then in a zigzag line as the branchlets, occasionally exceeding the leaves in length. Flowers, pods, and seeds as in the typical *A. retinodes.*

This Acacia has been brought under my notice several times during the last ten years by Mr. Walter Gill, Conservator of Forests of South Australia. The late J. G. Luehmann, following Bentham, always named it *A. pycnantha*, Benth., var. *angustifolia*, Benth., but while not agreeing with Bentham's view I did not wish to pronounce judgment until I had seen the plant growing naturally. This opportunity presented itself to me on the January, 1907, trip. Mr. Gill's notes are, "No higher than 5-7 ft. Has a decidedly drooping habit. Marble Range, December, 1897," "Two miles out on the western road from Port Lincoln. December, 1900." In examining some plants in the Herbarium of the University of Adelaide I found the plant described as, "Wand-like stem, 3 and 4 to 6 ft. high, drooping at the summit. Heath lands, Port Lincoln" (Professor R. Tate, without date).

I found it to be a thin, straggly, wiry shrub of 6 ft. or so. Extends over a considerable area in the Port Lincoln district—*e.g.*, at Green Patch and the Marble Range (January, 1907). I cannot see that it is sufficiently distinct from *A. retinodes*, Schl., to warrant its description as a new species, although its appearance is striking enough. The most striking difference of the variety *Gillii* consists, in my opinion, in the flexuous branches and inflorescence. In some specimens collected by me some of the branches and nearly all the racemes are actually zigzag. The phyllodes spread generally at a right angle from the branches, and are frequently even reflexed. The pedicels on the raceme are also frequently reflexed or spread at a right angle. In *A. retinodes* the branches are straight, the petiole of the phyllodes forms an acute angle with the branch, and the raceme is straight, with more erect pedicels, rarely spreading in a right angle. In *A. retinodes* the raceme is much shorter than the leaves; in the new variety the raceme is often longer than the leaves, at least in the specimens from Port Lincoln, (J. H. M., January, 1907), but the inflorescence seems to be very variable in this new variety. In the Marble Range (W. Gill) specimens the inflorescence is one-headed, the head on rather long, spreading, or reflexed peduncles. This seems to be the normal inflorescence, and the zigzag racemes in the Port Lincoln specimens are merely the upper parts of leafless branches. Of course, all racemes can be regarded as leafless branches with axillary racemes, but the transition state is very apparent in forms of the new variety, while the typical *A. retinodes* has true racemes. The new variety frequents dry situations; the normal species is usually found in depressed and moist situations. The name *Gillii* will commem-

orate Mr. Walter Gill, F.L.S., and also Mr. Thomas Gill, I.S.O., to whom I have already alluded.

A. rigens, A. Cunn. A very broad-podded form. Port Augusta. Figured in Part xxx. of my "Forest Flora of New South Wales."

A. rupicola, F. v. M. A very ornamental floriferous wattle of 2-3 ft. at Kirton Point and Port Lincoln to Coffin Bay. Cape Donington (R. S. Rogers).

A. salicina, Lindl. Murray Bridge.

A. salicina, Lindl., var. *Wayæ*, **new var.** A specially compact umbrageous shrub of 3-6 ft. high, chiefly distinguished by its habit and by its moniliform pods, which are not fleshy at maturity as in the normal species. The flowers are also frequently less than 20 in the head. A beautiful small variety for cultivation, with bright-yellow flowers borne in great profusion. Port Lincoln; also found at various places on road to Wangary. Near a well at Dutton Bay a bushy shrub of 5-6 ft. Thistle Island. At Kingscote (Kangaroo Island), a shrub of 3-4 ft. Collected by Dr. R. S. Rogers at Port Elliston and Marion Bay.

In the University Herbarium, Adelaide, from Southern Yorke Peninsula, Kellidie Bay, and Ardrossan (the last in immature fruit only and therefore doubtful). All collected by Professor Tate.

This beautiful wattle is named in honour of Sir Samuel Way, Chief Justice and Lieut.-Governor of South Australia, Vice-Patron of the Australasian Association for the Advancement of Science (Adelaide meeting). It is much admired in the Botanic Gardens, Sydney.

A. spinescens, Benth. Murray Bridge.

A. tetragonophylla, F. v. M. Aldgate.

A. verniciflua, A. Cunn. Aldgate.

Additional Acacia Notes.

The following notes are based on specimens in the Adelaide University Herbarium:—

A. Cambagei, R. T. Baker.

Cootanoorinna Creek, S.A., May 10, 1891; Arkaringa Creek, S.A., May 15, 1891; Gidgea; No. 32, Warrina, May, 1891.

All by R. Helms, Elder Exploring Exp. and named by Tate (following Mueller) *A. homalophylla*, A. Cunn., are *A. Cambagei*, R. T. Baker.

I have not seen specimens of *A. homalophylla*, A. Cunn., from South Australia, and the species should be looked for in that State.

A. Merralli, F. v. M.

Camp 66, September 30, 1891; W.A. Elder Exped. and *Acacia* (Tietkens, or Fowler Bay), both labelled by Tate *Meissneri;* should be *A. Merrallii*, F. v. M.

Probably Fowler Bay is correct, as there is a specimen of *A. Merralli* from "near Charra, Fowler Bay, Mrs. A. Richards," labelled *obliqua*.

EUCALYPTUS

(in alphabetical order).

1. *E. calycogona*, Turcz., var. *gracilis*, Maiden (*E. gracilis*, F. v. M., *partim*. See figures and full details in Part iii. of my "Critical Revision of the Genus Eucalyptus"). On Boston Island, Port Lincoln, it attains the largest size I noted on the trip; a tall, graceful Mallee, with smooth bark and narrow leaves, of a height of 30 ft. and a diameter of trunk up to 1 ft. It occurs also at Stamford Hill (not high up), at Memory Cove, and at Murray Bridge, including a form with apparently larger fruits. Timber brown. Fruits, suckers, and very young buds only seen. Found also at Cape Donington (Port Lincoln) and Fowler Bay (Dr. R. S. Rogers).

2. *E. capitellata*, Sm. Mount Lofty Range. My specimens come very near the type (Port Jackson). See my "Critical Revision of the Genus Eucalyptus," Part viii., p. 218.

3. *E. cladocalyx*, F. v. M. (*E. corynocalyx*, F. v. M.). For remarks on the synonymy of this species see Proc. Linn. Soc., N.S.W., xxix., 768. I studied this species pretty carefully from Port Lincoln to Lake Wangary, where, however, the most valuable trees do not grow (the type, however, comes from the Marble Range, close by Lake Wangary). It is, in this district, an inferior species, and the warning is not inappropriate that seed collected from localities such as this will produce inferior trees. It is a White Gum, more or less scaly-barked like the eastern *hæmastoma*. Rather straggling and spreading, a good head of dark-coloured, rather broadish, shiny foliage. Timber whitish, hence "White Gum"; looked upon locally as inferior to Red (*leucoxylon*). "White ants go through it," I was informed locally. At 7-8 miles from Port Lincoln (old road); it often has the grey bark of one of the New South Wales Grey Gums (*punctata*). Timber pale, but slightly brown in the middle. Abundant at 11 miles. It often sheds the greyish outer bark, and then becomes smooth brown all over like the eastern *Angophora lanceolata*. At 12-14 miles we have an association between

it and *Xanthorrhœa semiplana*. The *cladocalyx* does not impress me here. It reminds me of *Angophora lanceolata* in its goutiness and gnarledness. It has a thick, sappy bark of a rich orange colour. I also collected the species at Port Augusta.

4. *E. cneorifolia*, DC. The "Narrow-leaf" of Kangaroo Island. At Hog Bay it has a white stem and is rather tall, up to 40 ft. when allowed to grow singly, but is usually cut down, or of much smaller growth. As a large tree the bark is slightly ribbony, the trunk rough, or box-scaly. It has very narrow suckers and forms a scrub of extraordinary denseness, impenetrable. The timber is red, both of the large trees and the small scrubby form. Collected also at Kingscote. The superficial resemblance between the ripe fruits, in dense clusters, and those of *E. incrassata*, var. *conglobata*, is remarkable. The ripe buds, "egg in eggcup," also display a considerable resemblance to those of var. *dumosa*. The narrowness of the leaves and the redness of the timber, however, sharply separate *E. cneorifolia* from any form of *incrassata*.

5. *E. cosmophylla*, F. v. M. Mount Lofty Range. This appears to be the only species of Eucalyptus endemic to South Australia. The fruits vary much in size, those from $\frac{1}{2}$ in. bare to $\frac{3}{4}$ in. full, being found on the same branch. It is abundant, both shrubs and small trees; bark ribbony, forming a straggly, twisted tree. I have known it to be called "Blue Gum." It is, however, not generally known that *E. cosmophylla* may attain a considerable size. In 1904 Mr. Walter Gill, Conservator of Forests, Adelaide, wrote to me that in the Hundred of Kuitpo he had measured a tree 2 ft. 6 in. in diameter! It had 14 ft. of a trunk before branching, and it then carried a head reaching quite 50 ft. from the ground.

6. *E. diversifolia*, Bonpl. (See Part vii., "Crit. Rev. Eucal.") It is the commonest Eucalypt between Port Lincoln and Lake Wangary, existing in the greatest profusion. The leaves of the seedlings vary a good deal, some of them being stem-clasping and quite broadish. On Thistle Island it is, say, 15 ft. high, and with a stem diameter of 4 in. It has grey, thin bark, which peels a little. The timber is pale throughout, darkening a little towards the centre. The sizes of the fruits vary. Dr. Rogers collected it at Cape Couedic (Kangaroo Island). Tate,[3] following Bentham, refers *E. Barteri*, "established on Kangaroo Island samples," to this species. At p. 213, Part viii., of my "Critical Re-

[3] Trans. Roy. Soc. S.A. vi., 141 (1883).

vision " I have referred it to *E. capitellata*, Sm., and to this opinion I adhere until a view of better specimens than I have seen in various herbaria shows this opinion to be an erroneous one.

7. *E. fasciculosa*, F. v. M., is at Aldgate a small tree. "*E. largiflorens*, a Gum, 40 ft. high. Trunk grey. Bark corky, $\frac{1}{8}$ in., but thickening to $\frac{1}{4}$ in. in old trees. Western Cove, Nepean Bay (Kangaroo Island), Professor Tate, 1881," is in fruit only, and is, I think, *E. fasciculosa*. I hope the species will be looked for on the Island. A similar specimen by Tate in the herbarium of the University of Adelaide from "The Wells" (Kangaroo Island) is labelled by him "*largiflorens* var. or (?) *hemiphloia*." In the Adelaide University Herbarium is a specimen in bud and flower labelled by Tate "*E. paniculata*, Kankarilla, October 9, 1882," also, "Tea-tree Gully, December, 1882," and "Willunga Road, February, 1883." This is really *E. fasciculosa*, F. v. M., a species suppressed by Mueller himself in favour of *E. paniculata*, Sm., which is a very different tree. *E. paniculata* should be removed from the flora of South Australia and *E. fasciculosa* substituted therefor.

8. *E. Gunnii*, Hook, f. var. *rubida*, Maiden (*E. rubida*, Deane and Maiden). Large trees near water occur at Aldgate.

9. *E. incrassata*, Labill. For figures of this variable species see "Crit. Rev. Eucal.," Part iv. Specimens collected at Murray Bridge have the fruits slightly corrugated, and, as regards size, intermediate between those of the type and of var. *angulosa*. It does not seem worth while to designate it as a new variety.

(a) Var. *dumosa*, F. v. M. At Hog Bay (Kangaroo Island) this form was known as "Wakeri" (my spelling; I do not know whether it is correct) Gum or Mallee. This form has mallee-like stems, and is 20 ft. high; bark hard or ribbony to smooth, dirty grey; leafy, umbrella-like tops. It is nearest to var. *dumosa*, but the fruits are rather larger and more conoid than those of the type. At Kingscote, on the same island, var. *dumosa* has clean stems, and is, say, 20-25 ft. high. It is abundant, and the principal firewood. The timber is pale-coloured, neither red nor brown. At Murray Bridge it is a "Broad-leaved or White Mallee." It has dirty grey stems, less red in the bark than *E. uncinata*; timber pale. At Memory Cove it is the principal Eucalypt near the beach. It is not rare at Port Lincoln (Kirton Point), but appears to be uncommon on the Lake Wangary Road. At, say, $2\frac{1}{2}$ miles from Port Lincoln (old road) the buds of var. *dumosa* display considerable similarity to those of var. *conglobata*.

(b) Var. *conglobata*. Port Lincoln is the home of this variety, and I hitherto understood it to be always a shrubby form, but it attains the dignity of a medium-sized tree. At Boston Island the largest tree I saw is 2 ft. diameter for a stem of 6 ft.; a spreading, straggly tree. It attains a height of 30-35 ft. with smooth or ribbony stems, many of which are 9 in. to 1 ft. in diameter. Mr. Dabovich, of Port Lincoln, says there are some on the island 50 ft. high. I saw some trees of this height on the island, but not close enough to distinguish the species. At Kirton Point it is a strong, coarse-growing, tall shrub near the sea, but larger away from it. It occurs halfway down Stamford Hill. On the western road from Port Lincoln it seems to first appear at 2½ miles (old road). Timber pale throughout (small saplings).

(c) Var. *angulosa*. This variety was the scarcest on my trip. It occurs at Kirton Point; it is common around the Flinders Monument (Stamford Hill). It was noticed at 18 miles from Port Lincoln, along the western road, with unusually elongated cylindrical fruits.

10. *E. leucoxylon*, F. v. M., is a common tree in South Australia. I collected it at Mount Barker and Aldgate. At Cape Jervis it is a gnarled, spreading tree, say of 20 ft., with a smooth stem. In the Port Lincoln district it bears the name of "Red Gum," and it attains a large size. On the western road it is not very abundant. At 11-12 miles it is common, and on the edges of the Swamp, "Sinclair's Washpool" (19 miles), are fine trees. The red-flowering form appears to be rare. It occurs at 11 miles from Port Lincoln.

11. *E. obliqua*, L'Hér. (See "Crit. Rev. Eucal.," Part ii.) The fruit varies, sometimes approaching ovoid, sometimes nearly hemispherical. There is a good deal of variation in the texture of the bark.

The types of *E. falcifolia*, Miq. (see "Crit. Rev. Eucal.," ii., 61): *E. fabrorum*, Schl. *(op. cit.*, p. 60), come from the Mount Lofty Range.

12. *E. odorata*, Behr. This is a very abundant species and very variable. It has now a rather complicated synonymy.[4] Following are some field notes on the forms seen by me on the trip. It usually goes by the name of "Peppermint." The height to which the scaly or subfibrous bark occurs up the trunk varies a good deal; the timber is brown. Sometimes it is a fairly large tree: often it is only a tall shrub. It may, for the purposes of these notes, be divided

[4] See my paper in these Trans. xxvii., 240 (1903), in part.

into certain forms, which, however, run into each other: —

Form 1. Leaves thicker, and usually narrower; often more or less glaucous. Oil dots not prominent. Fruits nearly sessile, reminding one of those of *incrassata*, var. *dumosa*, and with little or no rim, except when unripe. This form, the type, is nearest to that named *E. cajuputea*,[5] F. v. M. This form includes *E. odorata*, Behr., var. *erythrandra*, F. v. M.[6] This is so named because of its dark-coloured (red) filaments which do not show this colour (or very rarely) when fresh, but which darken with age. I got *Form 1* mostly on the Port Lincoln-Wangary Road. At 7-8 miles it is in mallee form. At 13 miles we have a "Peppermint Mallee" or "Black Mallee." I only got green buds and unripe fruits and suckers. Smooth bark, or a little ribbony, a very little scaly near ground. Wood pale-brown like normal *odorata*. At 13-14 miles I collected a very broad-leaved form, which at the time reminded me of *E. incrassata*, var. *dumosa*. At the same time it has not the fruit-rim of typical *E. odorata*, except perhaps when young. At 14-15 miles are small trees, almost mallee-like. Smooth, ribbony towards butt, with a little scaly bark. Timber brownish towards centre. *E. cajuputea*, F. v. M., appears to be that form of *E. odorata* nearest to *E. polybractea*, R. T. Baker (*E. fruticelorum*, F. v. M.). The oils of *E. odorata* and *E. polybractea* are identical in composition. See "Research on the Eucalypts" (Baker and Smith).

Form 2 (*E. calcicultrix*, F. v. M.). Leaves sap green, thinnish, and oil dots rather prominent. Fruits pedicellate and with marked rims. The juvenile leaves sometimes glaucous! Murray Bridge specimens have leaves with crenulate margins and prominent oil dots; brown, not red, timber. Some of the fruits are pear-shaped (? showing hybridization). This is the ordinary *odorata* of Murray Bridge, and some are large trees; Mr. Cambage and I did not find any tree belonging to the *odorata* group with a red timber. At Cape Jervis at first forms dense, stunted masses of 1-3 ft. Almost mallee-like, suckers narrowish. Oil dots of leaves prominent; variation in width of juvenile leaves remarkable. A little further from the sea it is a small tree of, say, 20-25 ft., forming a belt. It is nearest of all the Mallees to the shore. It is the commonest tree Eucalypt about Port Lincoln. It seems to prefer limestone. It is sometimes a small, straggling tree with black, rough bark. It is also a medium-sized tree of drooping habit. The oil dots are not so prominent as in the Murray Bridge specimens.

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(5) These Trans. xxvii., 242.

(6) *Ib.*, 243.

Form 3. This is a form with purple flowers, for which I propose the name var. *purpurascens*, var. nov. Its partial synonymy is *E. Behriana*, F. v. M., var. *purpurascens*, F. v. M.;[7] *E. purpurascens*, F. v. M.; *E. hemiphloia*, F. v. M., var. *purpurascens; E. Lansdowneana*, Mueller and J. E. Brown.[8] The forms under the above names have puzzled a good many people, because there is absolute transition between white- and pink- (sometimes deep pink) coloured flowers. Following are field notes, and of some value for that reason.

"Red Mallee" seems to be commonest in the Port Lincoln district; it is pink-flowering and very pretty. It is usually a straggling, small tree of 10 ft. and more, with a stem of 3 or 4 in. It is certainly not a variety of *E. hemiphloia*, as has been supposed, from herbarium material. "Pink Mallee"—for so it is also called—is at Kirton Point much like *E. incrassata*, var. *dumosa;* it has a small operculum, but this is never grooved, and it is more pointed and less rounded than that of var. *dumosa*. Pink Mallee is usually more compact in habit than the latter. The pale-pink mallee occasionally attains the height of a tree, *e.g.*, at Kirton Point, where it is 1 ft. in diameter, and at other places as much and more. It is common for a few miles along the western road from Port Lincoln.

I cannot see any morphological difference between the Pink Mallee and the tree known as Peppermint (*odorata*). The Peppermint, the Pink Mallee, and the "White" Pink Mallee (that is to say, Mallee that cannot be distinguished from pink except by its white filaments) are all in flower at the same stage. At $2\frac{1}{2}$ miles on the old road I cut some timber of pink-flowering mallee. It is brown inside. I also cut a piece of white-flowering mallee. I could detect no difference in the two timbers. If we turn to B. Fl., iii., 214, we have the description of *E. hemiphloia*, var. *purpurascens*, from "Lake Wangaroo (Wilhelmi)." The modern spelling of this is Wangary, and most of my specimens were collected and my observations made along the Port Lincoln-Lake Wangary Road.

Then we have *E. Lansdowneana*, F. v. M. and J. E. Brown, figured and described as the "Red-flowering Mallee." It was collected by Mr. Thomas Lansdowne Browne on his "Pandura Run" in the Gawler Ranges. "In the district where found the species is locally

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[7] These Trans. xxvi., 12 (1902).

[8] Brown's "Forest Flora of South Australia," part ix., t. 31 (1890).

referred to as the 'Red-flowering Mallee,' but Mr. Browne explains that it is not a mallee proper, as it rises with one stem only, like any ordinary tree." . . . "Imperfect specimens of this species were collected in 1847 near Encounter Bay by C. Stuart, others in 1851 near Port Lincoln by C. Wilhelmi." Luehmann says, "*E. Lansdowneana*. I have seen neither a specimen nor description, and Tate, who has seen the plant, says it is not a tenable species" (Proc. A.A.A.S., Sydney, 1898, p. 535). There is a fragment in the herbarium of the University of Adelaide. The plant, like the rest of the "Pink" or "Red Mallee" of Port Lincoln, is referable to *E. odorata*, of which it is a variety, though not a strong one. The name var. *purpurascens* may be proposed for it, but it must be borne in mind that the pink or purple colouration of the filaments is not constant. The type specimen of *E. Lansdowneana* from the Gawler Range is of a deeper purple than I have seen it anywhere else.

Sometimes *E. odorata* is coarse and broad-leaved; this form is a good deal like *E. Behriana*, but the timber is brown, not red, as in *E. Behriana*. This form is common near the seacoast. Then at Hog Bay (Kangaroo Island) we have a "Peppermint" which is referable to *E. odorata*, though not typical. It is a small tree, and the timber is esteemed for fencing. It has a black-looking bark like *odorata*, very scaly, ribbony, rough branches: timber pale-brown: oil dots of leaves prominent.

We now turn to a very small-fruited form of *E. odorata*, at 10-11 miles (Port Lincoln to Lake Wangary), and also vicinity of Tumby Bay. It is a small-fruited, narrow-leaved Mallee, with pale-brown timber and a ribbony, rough butt. Only green fruits and very young buds were collected, but the smallness of the fruits is an additional instance of the variability of the species. I have dealt with *E. odorata* at some length, because South Australia is the principal home of the species, and it is so puzzling that I made special arrangements to study it.

13. *E. oleosa*, F. v. M., was collected at Murray Bridge, Cape Jervis, and Port Lincoln. At Murray Bridge it was in full flower; flowers large, white to yellow, young tips of branches red, often the bark red, hence the name "Red Mallee." Glaucous buds, pointed operculum, broad, glaucous suckers. At Cape Jervis it was a small tree of 15 ft. It is far less abundant than *E. uncinata* in the district; it it apparently rarely gregarious. Operculum blunt, buds almost ovoid. At Kirton Point it was in full flower, and a

beautiful object, with its large flowers and numerous yellow stamens. Operculum medium, and the fruits varying in shape.

14. *E. rostrata*, Schl. This is a common tree in South Australia, so that brief notes will suffice. At 7-8 miles, junction of old and new roads, Port Lincoln to Lake Wangary, it is a smooth-barked, straggly tree, larger than the local *E. cladocalyx*. Scaly, black-barked at bottom of butt. At 16 miles the trees are larger, forming an avenue on both sides of the road. It is the prevalent gum on the branch road from Wangary to Dutton Bay.

15. *E. uncinata*, Turcz. At Murray Bridge, a graceful-looking, narrow-leaved, "broom-top" mallee. Timber pale red or pink, when fresh. Suckers glaucous and broad in comparison with their width. At Cape Jervis it is very abundant, and, say, 10 ft. high. It occurs sparingly from Port Lincoln to Coffin Bay. At 15-16 miles it is a small Mallee, very ribbony; timber red and tough. Opercula red.

16. *E. viminalis*, Labill. Collected at Aldgate, Mount Lofty Range.

Appendix.

A. *E. amygdalina*, Labill. A specimen in the herbarium of the University of Adelaide labelled by Tate "*E. amygdadina*, Nangwary Forest Reserve and Tarpeena, J. E. Brown and R. Tate, November 22, 1882," is in bud and flower, and is doubtfully that species. It requires further investigation if on that specimen depends the inclusion of the species into the flora of South Australia.

B. *E. Stuartiana*, F. v. M. A specimen in bud only (in threes) from "Bigg Flat, December 9, 1883," is in the herbarium of the University of Adelaide. It was labelled *E. Stuartiana* by Tate. It is most probably *E. Gunnii*, Hook, f. var. *rubida*, Maiden (*E. rubida*, Deane and Maiden). I do not know on what authority Tate includes *E. Stuartiana* in the flora of South Australia. I do not say that it does not occur in that Province, but its occurrence should be proved.

C. *E. goniocalyx*, F. v. M. A specimen in the herbarium of the University of Adelaide, labelled by Tate "*E. goniocalyx*, Teatree Gully," is *E. Cambagei*, Deane and Maiden. I have never seen a specimen of the true *goniocalyx* from South Australia, and recommend its removal from the flora of that Province and substitution of *E. Cambagei*.

D. *E. macrorrhyncha*, F. v. M. A specimen in the herbarium of the University of Adelaide, labelled by Tate

"*E. macrorrhyncha*, F. v. M., (?) Aldgate, R. Tate, January 9, 1883," is *E. obliqua*, L'Hér. If *E. macrorrhyncha* has been admitted to the flora of South Australia on the authority of that specimen, it should be removed.

Summary (Eucalyptus).

1. *E. fasciculosa*, F. v. M., should be added to the flora of South Australia, vice *E. paniculata*, Sm.
2. *E. odorata*, Behr., var. *purpurascens*, Maiden, is a new variety.
3, 4, 5. *E. amygdalina*, Labill., *E. macrorrhyncha*, F. v. M., and *E. Stuartiana*, F. v. M., are doubtful members of the flora of South Australia.
6. *E. Cambagei*, Deane and Maiden, should be added to the flora of South Australia, vice *E. goniocalyx*, F. v. M.

Description of a Hitherto Undescribed Species of Shark from Investigator Strait.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read September 8, 1908.]

Scyllium vincenti, sp. nov.

This species belongs to the group which has the nasal valves not confluent and without cirrus. The interspace between the nasal valves is about as wide as the flaps, which are turned up at their posterior margin. A short labial fold round the angle of the mouth, each about one-fifth of the length of the jaw. Teeth small, with a long median cusp and a small cusp on each side. Gill openings narrow, the first the largest, the following smaller, the last one only half the length of the first; the last two are situated above the base of the pectorals. The first dorsal has its origin behind the middle of the total length. Both dorsals are of about equal length. The origin of the anal is a little behind the first dorsal and terminates about the middle of the second dorsal. The lower caudal lobe originates about opposite the termination of the second dorsal. The base of the ventrals at their posterior margin is opposite the origin of the first dorsal. The ventrals terminate in a point. The caudal has a notch at three-quarters of its length and terminates in a rounded flap. The skin is very finely chagreened and glossy; the dermal denticles are three cuspid and very finely grooved. The colour is a reddish-brown above and on the sides, with indistinct darker crossbars, which are widest on the back. The head is uniformly dark-brown above. The rest of the trunk carries scattered, small, and indistinct whitish spots. The fins are darkest in the centre, but their margin is whitish. Under side, dirty white. The largest specimen is about 18 in. long. The first specimen I obtained from a fisherman, who caught it near the northern shore of Kangaroo Island while fishing for schnapper.

A Synopsis of the Fishes of South Australia. Part I.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read September 8, 1908.]

Introduction.

The first part of this deals with the Plagiostomi, in relation to which I have adopted Professor T. W. Bridge's classification. In the Teleostei I have followed the classification given by Mr. G. A. Boulenger.[1] Considerable difficulties have been experienced in identifying some species, owing to the absence of important literature on the subject, and also from the fact that none of the specimens identified and described by the late Count de Castelnau were available for comparison.

The only list of South Australian fishes hitherto published was the one by the late Count de Castelnau in the Annual Report of the Acclimatization Society of Victoria for the year 1872, in which twenty-seven species are enumerated. This list was based upon the material collected chiefly in Gulf St. Vincent by the first Curator of the South Australian Museum, Mr. G. Waterhouse. About half a dozen species were subsequently described by Messrs. Ramsay and Ogilby, and also by Mr. de Vis, in the Proc. Linnean Society, New South Wales.

I wish to express my thanks to those who have kindly supplied me with specimens, and particularly to Dr. J. C. Verco, F.R.C.S., etc., who kindly invited me to join him on his dredging trips, which afforded an unusual opportunity for obtaining fresh material. A number of species new to me and also new to science were thereby obtained.

It is intended to publish this synopsis in parts.

Class, **LEPTOCARDII** (Lancelets).

Family, BRANCHIOSTOMATIDÆ.

Genus, Asymetron, Andrews (1893).

A single specimen of a Lancelet was dredged in about 100 fathoms of water about 40 miles east of Cape Spencer. It was placed in a glass tube with seawater, but owing to an accident with the machinery of the small steamer, and the approach of rough weather, it had to be packed away,

[1] See the Cambridge Natural History, etc., vol. vii., 1904.

and was lost sight of for several days. When examining it later it was found to be decomposed. For this reason the species could not be identified.

Class, **CYCLOSTOMATA.**

Order, *PETROMYZONTES.*

Family, PETROMYZONTIDÆ.

Genus, GEOTRIA, Gray (1851).

1. **Geotria australis,** Gray.

Proc. Zool. Soc., Lond., 1851, p. 238, pl. iv., figs. 3 and 4. (Wide-mouthed Lamprey.)

Genus, MORDACIA, Gray (1851).

2. **Mordacia mordax,** Rich.

(Male; female unknown.)

Voy. Ereb. and Terr., 1846, p. 62, pl. xxxviii., figs. 3-6. (Short-headed Lamprey.)

Genus, CARAGOLA, Gray.

3. **Caragola,** sp.

Class, **PISCES** (Fishes).

Order, *PLAGIOSTOMI* (Sharks and Rays).

Sub-order, *SELACHII.*

Family, NOTIDANIDÆ.

Genus, NOTORHYNCHUS, Ayres (1856).

4. **Notorhynchus indicus,** Agass.

Poiss. Foss. Feuilleton, 1835, p. 71. (Seven-gilled Shark.)

Family, HETERODONTIDÆ.

Genus, HETERODONTUS, Blainv. (1816).

5. **Heterodontus philippi,** Bl.

Schn. Syst. Ichth., 1810, p. 134. McCoy, Prod. Z. Vict. dec., xii., p. 113. (Port Jackson Shark.)

Family, SCYLLIDÆ.

Genus, SCYLLIUM, Cuv. Régne, An.

6. **Scyllium vincenti,** Zietz.

Trans. Roy. Soc., S.A., 1908, vol. xxxi., p. 287.

Genus, PARASCYLLIUM, Gill (1861).

7. **Parascyllium nuchale,** McCoy.

Ann. and Mag. Nat. Hist., 1874, xiii., p. 15, pl. ii.

A single specimen, 12 in. long, washed up at Brighton Beach, Gulf St. Vincent.

Family, HEMISCILLIIDÆ.

Genus, ORECTOLOBUS, Bonap. (1836).

8. **Orectolobus barbatus,** Gmel.

Syst. Nat., ed. xiii., 1789, p. 1493. McCoy, Prod. Z. Vict., dec. v., pl. xliii., fig. i. (Carpet Shark.)

Family, CARCHARIIDÆ.

Genus, MUSTELUS, Link. (1790).

9. **Mustelus antarcticus,** Gunth.

Cat. Fish., viii., 1870, p. 387. McCoy, Prod. Z. Vict., dec. ix., pl. lxxxvii., fig. i. (Sweet William.)

Genus, GALEOCERDO, Müll. and Henle (1837).

10. **Galeocerdo rayneri,** McDon. and Bar.

Proc. Z.S., 1868, p. 368, pl. xxxii. (Tiger Shark.)

This fish is enumerated in this list upon the evidence of a number of jaws from specimens caught by local fishermen, and which I referred to this species. The fish figured by Macleay in the Proc. L.S., New South Wales, seems to differ from the one figured by Day in his "Fishes of India." I have never seen this fish in a fresh state.

Genus, CARCHARIAS, Rafin (1810).

11. **Carcharias gangeticus,** Müll. and Henle.

Plagiost., 1838, p. 39, pl. xiii. (Sea Shark.)

Genus, PRIONACE, Cantor (1850).

12. **Prionace glauca,** Linn.

Syst. Nat., ed. x., 1758, p. 235. Müll. and Henle, Plagiostoma, pl. xi. (Blue Shark.)

Genus, TRIACIS, Müll. and Henle.

13. **Triacis scyllium,** Müll. and Henle., p. 63, pl. xxvi.

A single specimen, over 3 ft. long, was caught by the late Dr. Wylde off the Semaphore Jetty, Gulf St. Vincent. The type specimen came from Japan.

Genus, GALEUS, Cuv.

14. **Galeus australis,** Macleay,

Proc. L.S., New South Wales, vi., 1881, p. 354. McCoy, Prod. Z. Vict., dec. vii., pl. lxiv., fig. ii. (School Shark.)

Family, SPHYRNIDÆ.

Genus, SPHYRNA, Rafin (1810).

15. **Sphyrna malleus,** Shaw.

Nat. Misc., McCoy, Prod. Z. Vict., dec. vi., pl. lvi., fig. i. (Hammer-headed Shark.)

Family, ALOPIIDÆ.

Genus, Alopias, Rafin (1810).

16. **Alopias vulpes,** Gmel.

Syst. Nat., ed. xiii., 1789, p. 1496. McCoy, Prod. Z. Vict., dec. ix., pl. lxxxviii. (Thresher Shark.)

I have seen this fish repeatedly leaping high out of the water in front of the steamboat in which we were travelling near Beachport, S.E., on one of Dr. Verco's dredging trips.

Family, LAMNIDÆ.

Genus, Odontaspis, Rafin (1810).

17. **Odontaspis taurus,** Rafin.

Carat. Alc. Nuovi Gen., 1810, p. 10. McCoy, Prod. Z. Vict., dec. vii., pl. lxiv., fig. i. (Grey Nurse.)

Genus, Mitsukurina, Jordan.

18. **Mitsukurina owstoni,** Jordan.

Proc. California Acad. Sci. (3), Zool., vol. i., No. 6, 1898.

One specimen of this rare and highly interesting Japanese deep-sea shark, about 4 ft. long, was netted near the mouth of the River Murray. Mr. A. S. Woodward, the able Curator of the Palæonthological Department of the British Museum, wrote a most interesting account of its close relationship with the extinct *Scapanorhynchus*, and that among the recent species it appears to be nearest allied to *Odontaspis*.

Genus, Isuropsis, Gill (1861).

19. **Isuropsis glauca,** Müll. and Henle.

Plagiost., 1838, p. 69, pl. xxix. (Blue Pointer.)

Genus, Carcharodon, Smith (1837).

20. **Carcharodon carcharias,** Linn.

Syst. Nat., ed. x., 1758, p. 235. McCoy, Prod. Z. Vict., dec. viii., pl. lxxiv. (White Pointer.)

Family, CETORHINIDÆ.

Genus, Cetorhinus, Blainv. (1816).

21. **Cetorhinus maximus,** Gunner.

Trondh. Selskab, iii., 1765, p. 33. McCoy, Prod. Z. Vict., dec. xi., pl. civ. (Basking Shark.)

Only two young specimens, about 8-10 ft. long, were netted near our coast. Attains to a length of more than 30 ft.

Family, SPINACIDÆ.

Genus, ACANTHIAS, Risso (1826).

22. **Acanthias vulgaris,** Risso.

Eur. Mérid., iii., p. 131. Müll. and Henle, p. 83. (Picked Dog Shark.)

Family, PRISTIOPHORIDÆ.

Genus, PRISTIOPHORUS, Müll. and Henle (1837).

23. **Pristiophorus cirratus,** Lath.

T.L.S., ii., 1794, p. 281, pls. xxvi., xxvii., fig. v. (Saw Shark.)

Family, RHINIDÆ.

Genus, SQUATINA, Dum. (1806).

24. **Squatina squatina,** Linn.

Syst. Nat., ed. x., 1758, p. 233. McCoy, Prod. Z. Vict., dec. iv., pl. xxxiv. (Angel Shark.)

Family, RHINOBATIDÆ.

Genus, RHINOBATUS, Bl. Schn. (1801).

25. **Rhinobatus banksii,** Müll. and Henle.

Plagiost., 1838, p. 123. (Shovel-nosed Ray.)

Genus, TRIGONORRHINA, Müll. and Henle (1838).

26. **Trigonorrhina fasciata,** Müll. and Henle.

Plagiost., 1838, p. 124, pl. xliii. (Fiddler.)

Family, RAIIDÆ.

Genus, RAJA, Linn. (1758).

27. **Raja lamprieri,** Rich.

Ereb. and Terror, Pisces, p. 34, pl. xxiii. (Thorn-back Ray.)

Family, TORPEDINIDÆ.

Genus, HYPNOS, Dum. (1852).

28. **Hypnos subnigrum,** Dum.

Rev. Mag. Zool. (2), iv., 1852, p. 279, pl. xii. (Numb Fish or Electric Ray.)

Family, TRYGONIDÆ.

Genus, TRYGON, Müll. and Henle (1838).

29. **Trygon testacea,** Müll. and Henle.

Plagiost., 1838, p. 174, pl. lvii. (Common Sting Ray.)

Genus, DASYATIS, Rafin (1810).

30. **Dasyatis pastinaca,** Linn.

Syst. Nat., ed. xii., 1766, p. 396. Bloch. Ichth., iii., pl. lxxxii. (Smooth Sting Ray.)

Family, MYLIOBATIDÆ.

Genus, MYLIOBATIS, Dum. (1817).

31. **Myliobatis australis,** Macleay.

Proc. L.S., New South Wales, vi., 1881, p. 380. McCoy, Prod. Z. Vict., dec. vii., pl. lxiii. (Eagle Ray.)

Order, *HOLOCEPHALI* (Ghost Sharks).

Family, CHIMÆRIDÆ.

Genus, CALLORHYNCHUS, Gronovius.

32. **Callorhynchus antarcticus,** Lacép.

Hist. Poissons, i., p. 400, 1798. McCoy, Prod. Z. Vict., dec. ii., pl. cxii. (Elephant Shark.)

The number of Sharks and Rays inhabiting our coast must be much larger; but owing to the fishermen cutting them up for bait or otherwise destroying them when caught, they are but rarely available for scientific purposes.

A Synopsis of the Fishes of South Australia. Part II.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read October 6, 1908.]

Order, *TELEOSTEI* (True Fishes).
Sub-order, *MALACOPTERYGII.*
Family, CLUPEIDÆ.
Sub-family, ENGRAULINÆ.
Genus, Engraulis, Cuv. (1817).

33. **Engraulis antipodum,** Günth.

Cat. Fish., vii., 1868, p. 386. (Anchovy.)

The only time that I observed this fish was at Port Willunga, when great numbers leapt out of the water upon the sand.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Genus, Etrumeus, Bleek. (1853).

34. **Etrumeus jacksoniensis,** Macleay.

Proc. L.S., New South Wales, iii., 1878, p. 36, pl. iv., fig. i.

Gulf St. Vincent. I once noticed several specimens in a fishshop in Adelaide. Only four specimens are on record —three in the Australian Museum, Sydney, and one in the South Australian Museum.

Sub-family, CLUPEINÆ.
Genus, Clupea, Cuv.

35. **Clupea sagax,** Jen.

(Australian Pilchard or Sardine.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Genus, Dorosoma, Rafin (1820).

36. **Dorosoma Erebi,** Günth.

Cat. Fish., vii., 1868, p. 407. Rich. Voy. Ereb. and Terr., pl. xxxviii., figs. 7-10.

Lake Alexandrina, South Australia (Bony Bream).

Distribution—New South Wales, South Australia, Victoria.

Genus, SPRATELLOIDES, Bleeker.

37. **Spratelloides delicatulus (?)**, Beun.

Proc. Linn. Soc., New South Wales, vol. iv., p. 308.

Gulf St. Vincent. This species is recorded by Macleay from Darnley Island, but Day records a second species, *S. malabaricus*, Chevert Exped., from the west coast of India.

38. **Dorosoma horni**, Zietz.

Report on the work of the Horn Scientific Expedition to Central Australia.

River Finke, Central Australia. (Type in South Australian Museum.)

Genus, DIPLOMYSTUS, Cope.

Bull. U.S. Geol. Surv., Ferrit., vol. iii., p. 808.

39. **Diplomystus vittatus**, Zietz. M.S.

A single specimen belonging to this most interesting genus, which a few years ago embraced only fossil forms, I found washed up at Encounter Bay, March, 1886. This adds one more to the two species discovered by Mr. D. Ogilby on the coast of New South Wales.

Family, SALMONIDÆ.

Genus, RETROPINNA, Gill. (1862).

40. **Retropinna retropinna**, Rich.

Voy. Ereb. and Terr., 1848, p. 121, pl. lii., figs. 1-3. (Smelt.)

Lake Alexandrina, South Australia.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Family, GONORHYNCHIDÆ.

Genus, GONORHYNCHUS, Cuv. (1817).

41. **Gonorhynchus gonorhynchus**, Linn.

Syst. Nat., ed. xii., 1766, p. 523. Rich. Voy. Ereb. and Terr., pl. xxix., figs. 1-6. (Sand Fish.)

South Australian coast; also known from New Zealand, the Cape of Good Hope, and Japan.

Family, SILURIDÆ.

Sub-family, CLARIIDÆ.

Genus, CNIDOGLANIS, Günth. (1864).

42. **Cnidoglanis megastomus**, Rich.

Voy. Ereb. and Terr., 1845, p. 31, pl. xxi., figs. 1-3. (Estuary Cat Fish.)

Gulf St. Vincent; also Port Darwin, Northern Territory.

Distribution—North coast of Australia, New South Wales, South Australia, Victoria, Tasmania.

Genus, Copidoglanis, Günth. (1864).

43. **Copidoglanis tandanus,** Mitch.

Exp. Int. Aust., i., 1838, p. 95, pl. v., fig. ii. (Fresh-water Cat Fish.)

River Murray, South Australia.

Distribution—New South Wales, South Australia, Victoria, Western Australia.

Genus, Neoplotosus, Cast.

44. **Neoplotosus waterhousei,** Cast.

Research. Fish. of Australia, p. 45.

Gulf St. Vincent, South Australia (Castelnau).

I have not yet succeeded in finding a fish which corresponds with Castelnau's description.

Genus, Ostophycephalus, Ogilby.

45. **Ostophycephalus duriceps,** Ogilby.

Proc. L.S., New South Wales, vol. xxiv., pp. 154-186,

Gulf St. Vincent, South Australia, washed up (A. Zietz); (type) bad state.

Genus, Neosilurus, Steindachner.

46. **Neosilurus argenteus,** Zietz.

Report on the work of the Horn Scientific Exped. to Central Australia (Fishes). Appendix, pl. xvi., fig. vii.

In the original description I have placed this fish under *Plotosus*, which have eight barbels. The absence of the second dorsal fin would necessitate its removal to the genus *Neosilurus*, with only six barbels. The Central Australian form has eight barbels. For this reason I would suggest to unite this species with *Neosilurus*, and to divide this genus into two groups:—

(a) Species with six barbels—*Neosilurus hyrtlii*, Steind., and *N. australis*, Cast.

(b) Species with eight barbels—*N. argenteus*, Zietz. This would avoid the creation of a new genus for the Finke River and Cooper Creek fish.

Sub-order, *SYMBRANCHII.*

Family, SYMBRANCHIDÆ, Müll.

Abhandl. Ak. Wiss., Berlin, 1846, p. 193.

Genus, Symbranchus, Bloch.

47. **Symbranchus bengalensis,** Bleek.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Bengal, East Indian Archipelago, Dampier Archipelago, South Australian coast.

Genus, CHILOBRANCHUS, Rich. (1845).

48. **Chilobranchus rufus,** Macl.

Proc. L.S., New South Wales, vi., 1881, p. 266.

Gulf St. Vincent (Red-banded Shore-eel).

Distribution—New South Wales, South Australia, Victoria, Tasmania.

Sub-order, *APODES.*

Family, ANGUILLIDÆ.

Genus, ANGUILLA, Shaw (1804).

49. **Anguilla australis,** Rich.

Proc. Zool. Soc., 1841, p. 22, and Voy. Ereb. and Terr., pl. xiv., fig. i. (The Common Eel.)

Mount Gambier district, fresh water.

Genus, CONGER, Cuv.

50. **Conger wilsoni (?),** Cast.

(The Conger Eel.) South Australian coast.

This species has also been recorded from Victoria and Tasmania, but I am in doubt if the identification of our fish is correct.

Genus, MURÆNICHTHYS, Bleek. (1853).

51. **Murænichthys breviceps,** Günth.

Ann. and Mag. Nat. Hist., 1876, vol. xvii., p. 401.

Gulf St. Vincent and Spencer Gulf, Fowler Bay.

Distribution—South Australia, Tasmania.

Sub-order, *HAPLOMI.*

Family, GALAXIIDÆ.

Genus, GALAXIAS, Cuv. (1817).

52. **Galaxias attenuatus,** Jen.

South Australia. In all the rivers and creeks entering the sea. Also recorded from Victoria, Tasmania, New Zealand, Falkland Islands, Terra del Fuego, Magellan, and Peru (?).

53. **Galaxias olidus,** Günth.

Creeks in the Mount Lofty Ranges; only known from South Australia. (Butter Fish.)

54. **Galaxias coxii,** Macl.(?)

Morialta Falls (Glen Stuart), Mount Lofty Ranges. It is with some doubt that I include this fish in my list; it seems to agree with the description and figure; it is found in New South Wales and Victoria, but has not been previously recorded from this State. (Mountain Trout.)

Family, MYCTOPHIDÆ.

Genus, AULOPUS, Cuv. (1817).

55. **Aulopus purpurissatus,** Rich.

Icon. Pisc., 1843, p. vi., pl. ii., fig. iii. McCoy, Prod. Zool. Vict., dec. vi., pls. liv. and lv. (Sergeant Baker.)

South Australian and Victorian coasts, New South Wales, and Western Australia.

Family, SYNGNATHIDÆ.

Genus, SYNGNATHUS, Linn. (1758).

56. **Syngnathus curtirostris,** Cast.

Proc. Zool. Soc. Vict., vol. ii., p. 79.

Spencer Gulf, dredged (Dr. J. C. Verco).

57. **Syngnathus semifasciatus,** Günth.

Cat. Fish., viii., p. 162.

Spencer Gulf, dredged (Dr. J. C. Verco).

Whidbey Island, near Coffin Bay.

Distribution—South Australia, Port Phillip (Victoria), Tasmania.

58. **Syngnathus pœcilolæmus,** Peters.

Günth. Cat. Fish., viii., p. 174.

Gulf St. Vincent and Spencer Gulf, dredged (Dr. J. C. Verco).

59. **Syngnathus pelagicus,** Linn.

Günth. Cat. Fish., viii., p. 165.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Mediterranean Sea, Atlantic Ocean, Falkland Islands, New Zealand, China, Mauritius, South Australia.

60. **Syngnathus olivacea,** Cast.

Proc. Zool. Soc. Vict., vol. ii., p. 77.

Gulf St. Vincent and Spencer Gulf.

61. **Syngnathus argus,** Rich.

Trans. Zool. Soc., iii. p. 183, pl. vii., fig. ii.

Gulf St. Vincent and Spencer Gulf, Fowler Bay.

Distribution—New South Wales, South Australia.

Genus, ICHTHYOCAMPUS, Kaup. (1853).

62. **Ichthyocampus filum,** Günth.

Cat. Fish., viii., p. 178.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Western Australia, South Australia.

Genus, Leptoichthys, Kaup.

Lophobr., p. 51.

63. **Leptoichthys castelnaui,** Macleay.

Proc. Zool. Soc. Vict., vol. ii., p. 77.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—South Australia.

Genus, Doryichthys, Kaup.

Lophobr., p. 58.

64. **Doryichthys heterosoma,** Bleek.

Nat. Tyds. Ned. Ind., ii., p. 440.

Spencer Gulf, dredged; a single specimen (Dr. J. C. Verco).

Distribution—Borneo, South Australia.

Genus, Solenognathus, Swains. (1839).

65. **Solenognathus spinosissimus,** Günth.

(Male and Female.)

Near Port Lincoln, Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

Genus, Phyllopteryx, Swains. (1839).

66. **Phyllopteryx foliatus,** Shaw.

Gen. Zool., v., 1864, p. 456, pl. clxxx. (Leafy Sea-horse.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

67. **Phyllopteryx eques,** Günth.

Proc. Zool. Soc., 1865, p. 327, pl. xv. (Spiny Sea-dragon.)

Spencer Gulf.

Genus, Hippocampus, Rafin (1810).

68. **Hippocampus novæ-hollandiæ,** Steind.

S.B. Acad. d. Wiss. Wien, liii., 1866, p. 474, pl. i., fig. ii. (Common Sea-horse.)

Distribution—New South Wales, South Australia, Victoria.

69. **Hippocampus breviceps,** Peters.

M.B. Acad. d. Wiss., Berlin, 1869, p. 710. (Short-snouted Sea-horse.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

On a Want of Symmetry Shown by Secondary X-Rays

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide.

[Read September 8, 1908.]

(Abstract.)

Experiments were described showing that the secondary X radiation appearing on the emergence side of a plate traversed normally by X-rays, was in general greater than that appearing on the incidence side. Aluminium and celluloid showed the effect well, but copper and iron did not show it until all the softer portions of the secondary radiations had been removed by screens. The results were favourable to the theory that X-rays were of a material nature. See the following paper, p. 301.

On a Want of Symmetry Shown by Secondary X-Rays.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and J. L. Glasson.

[Read October 6, 1908.]

On the assumption that the Röntgen rays consist of æther pulses it has been shown by J. J. Thomson ("Cond. of Elect. through Gases," p. 323) that it is possible to account for the existence of secondary Röntgen rays by assuming that the primary pulses set in motion electrons over which they pass, and cause them to become new centres of radiation. If the electron easily follows the guiding force of the primary pulse, then the secondary radiation resembles the primary in quality. But if the electron is hampered by attachments to other portions of the atom to which it belongs, then the new pulse has not the same quality as the old; the time of motion of the electron is dragged out, and the pulse produced is softer.

Now, if an electron becomes in this way a centre of radiation the intensity of the secondary effect must be symmetrical about the line of motion of the electron. In particular, the intensity of the secondary radiation must be symmetrical about a plane passing through the electron perpendicular to the primary ray, since this ray contains the line of motion referred to. This deduction forms an integral part of Thomson's theory of secondary Röntgen radiation, and its truth has been assumed in calculations intended to show that experimental results are in agreement with theory. Barkla proves the same deduction in a paper published in "The Philosophical Magazine" of February, 1908.

Now it has recently been shown (Bragg and Madsen, Trans. Roy. Soc., S.A., May, 1908) that the cathode radiations excited by γ rays show a very marked want of symmetry about the plane normal to the exciting ray; and again (Madsen, Trans. Roy. Soc., S.A., July, 1908) that there is a similar want of symmetry in respect to the secondary γ rays. The γ rays and X-rays resemble one another so closely in all their known properties that it is fairly safe to assume any effect found to be true of the one kind to be true also of the other kind, though perhaps to a different degree. In this case indeed Cooksey ("Nature," April

2, 1908) has already shown that the secondary cathode radiations excited by X-rays are not at all symmetrical about the normal plane, the emergence rays being greater than the incidence, as in the case of the γ rays.

It remained, therefore, to examine the secondary X-rays excited by primary X-rays; and the experiments described

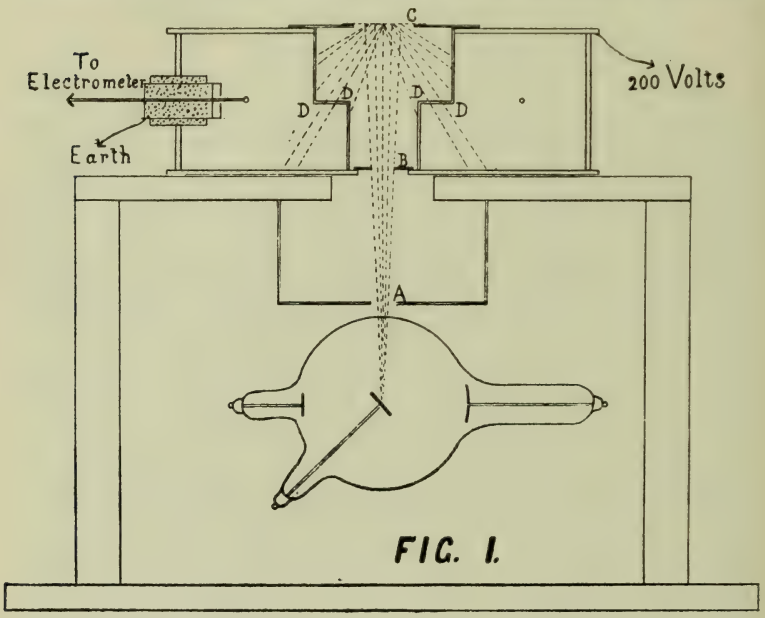
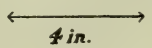


FIG. I.



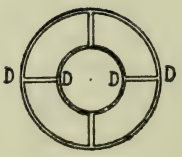


FIG. IV.

FIG. II.

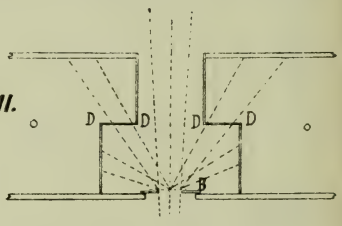
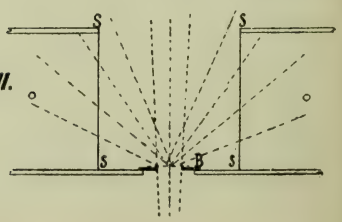


FIG. III.



in this paper were made with that object. We find that in general the effect does exist, that it is sometimes very pronounced, and that is in keeping with expectation based on Madsen's study of the secondary γ rays. Hard γ rays show a very large difference between the quantities of emergence and incidence radiation; for soft γ rays the difference is smaller. Since X-rays are to be looked on as a very soft form of γ rays, the difference should be smaller still; and this is what we have found to be the case.

The general form of the apparatus which we have used is shown in fig. i. Variations of the upper portion of it are shown in figs. ii and iii. A small pencil of X-rays passed upwards through apertures in lead plates at A and B, and then along the axis of the ionization chamber and out into the open. In our first experiments the upper part of the apparatus was arranged as in fig. iii. The primary rays did not pass through the effective part of the ionization chamber, being separated therefrom by the cylindrical screen S,S, which could be made of various thicknesses and various materials. But if a thin sheet of any substance was laid over the hole at B, secondary X-rays spread out therefrom, and some passed through the screen S,S and caused a deflection in the electrometer. The difference between the deflections *(a)* without and *(b)* with the sheet at B was taken as a measure of the emergence secondary X-ray radiation. When the sheet was removed from B, and the same or a similar sheet placed in the plane of the top of the screen so as to be struck from below by the primary rays, then the measure of the incidence secondary radiation was obtained as the difference between the deflections *(a)* without and *(c)* with the sheet so placed.

In this way it was easy to show that the expected want of symmetry actually existed, particularly with aluminium, celluloid, or paper as the radiators, substances of small atomic weight. But the experiments were open to some extent to the objection that a was too large compared with $b-c$, and that possibly the excess of emergence over incidence was an apparent effect due to actual variations of a under different circumstances. The current a was in fact due to several causes. There was a small natural ionization leak even when the X-rays were not acting; there was an effect due to primary X-rays which had penetrated the walls of the chamber though they were made of zinc, one-eighth of an inch thick. But the greatest part of a was due to a diffusion of soft rays about the primary beam, much of which came through the hole at B at such an angle as to penetrate the screen S,S; it could be largely cut out by thickening the

screen. Again, part of a was due to radiation returned from the open air above the ionization chamber. Some of these radiations might be appreciably interfered with by placing the radiating sheet at B or at the top of the chamber. We were, however, able to satisfy ourselves by special experiments that the want of symmetry was quite real, and that as a matter of fact no valid objection could be made. But we abandoned the first arrangement for a second which, as we expected, would show the want of symmetry more clearly, and which proved better than the first in every way. The first method was exactly the same as that used by Madsen in examining the secondary γ rays; but it was clear that the enormous difference which these rays showed was not going to be repeated in the case of the X-rays.

Our new arrangement was, as shown in fig. i., or, inverted, in fig. ii. Two cylinders of brass, each 2 in. long, but of different diameters—4 in. and 2 in.—were fixed to a connecting piece D,D, shown in plan in fig. iv. The latter resembled a light brass wheel with four spokes, and various thin screens cut in the form of flat rings could be attached to it, filling up all the spaces between the spokes. In fig. ii. the double cylinder is shown as arranged for the measurement of incidence secondary radiations; the radiating sheet was placed at C, supported by a sheet of celluloid lying flat on the top of the cylinder. A hole was cut in the centre of the celluloid sheet big enough to allow the primary beam to pass through without touching the edges; and a fluorescent screen was used to make sure that this was the case. The radiating sheets were of thin metal, about $1\frac{1}{2}$ in. square. In fig. ii. the cylinder is shown as arranged for the measurement of emergence secondary radiations; it hardly requires further explanation.

We expected that this arrangement would show up the want of symmetry better than the former, because the portions of the emergence and incidence beams under comparison would be more nearly normal to the plate. Looking upon the radiations as material we should naturally expect the intensity of the secondary radiation to decrease gradually as its direction increased in inclination to the forward direction of the primary ray. The emergence rays lie, in inclination, between 0 deg. and 90 deg.; the incidence between 90 deg. and 180 deg. In our first arrangement we compared the emergence rays between about 40 deg. and 90 deg. with the incidence rays between about 90 deg. and 140 deg. There should be a larger ratio of emergence to incidence with the newer arrangement, since the emergence rays between about 30 deg. and 50 deg. would be compared with the incidence

between about 130 deg. and 150 deg. This proved to be the case; the improvement was considerable. Again with the new arrangement the current with no radiator in position became relatively far smaller. For example, when the radiator was of Al, ·4 mm. thick, and the absorbing screen D,D of tinfoil (two thin sheets), the currents with and without the radiator at B in fig. i. caused deflections of 86 and 26 mm. in ten seconds respectively; the currents with and without the radiator at B in fig. ii. were 220 and 35 respectively. There could be very little error, therefore, in taking the incidence and emergence radiations as 60 and 185 respectively; and the want of symmetry is beyond doubt.

It should be observed that the emergence radiation can never be shown to an unfair advantage in these experiments, and is often at a disadvantage, for the radiator, when placed as in fig. ii., cuts down the very primary rays to which the secondary radiation is due. It is not difficult to show that if the thickness of the radiator is so adjusted as to give the maximum emergence current (it can of course be too thick or too thin), then the ratio of this maximum to the maximum incidence current (which can be obtained simply by making the radiator thick enough) is only $2/e$ of the true ratio of emergence to incidence; provided that the secondary rays are as penetrating as the primary, and that we are considering homogeneous radiations. But if, other conditions being the same, the secondary rays are less penetrating than the primary, then the ratio as found is more nearly correct, and is very nearly so when the secondary rays are much less penetrating than the primary, as, for example, when we are considering secondary cathode rays due to X- or γ rays.

We have made a large number of measurements by the method described above, using the following metal sheets as radiators:—Pt, weight per square cm., ·0150 gr.; Sn, ·0096 gr.; Cu, ·0083 gr.; Fe, ·0077 gr.; Al, ·105 gr.; celluloid, ·20 gr. As screens we have used various thicknesses of Sn, Cu, and Al.

The proportion of emergence to incidence radiation differs considerably for the different radiators, but is much the same for different screens or different thicknesses of screen, except that the proportion tends to increase slightly as the screen is made thicker; and the tendency is most pronounced in the case of those metals which give out a quantity of soft secondary radiation. For example, Fe and Cu show little difference between incidence and emergence radiations until the screen is so thick that only a small fraction of either of the radiations can pass through. The results

vary somewhat with the state of the bulb; and since these variations are comparable with those which are met with on changing the nature of the screens, we are not now in a position to discuss smaller variations in detail. We must content ourselves with quoting a few results in order to show the want of symmetry, which is a persistent effect. When, for example, two tinfoils were used as screen (weight per square cm. of each, ·0056), we obtained the following figures, which represent movements of the scale in mm. during 10 secs.: —

Radiator.	Sn	Cu	Fe	Al
Emergence Current	176	140	39	185
Incidence Current	122	119	15	60

With four tinfoils the figures were: —

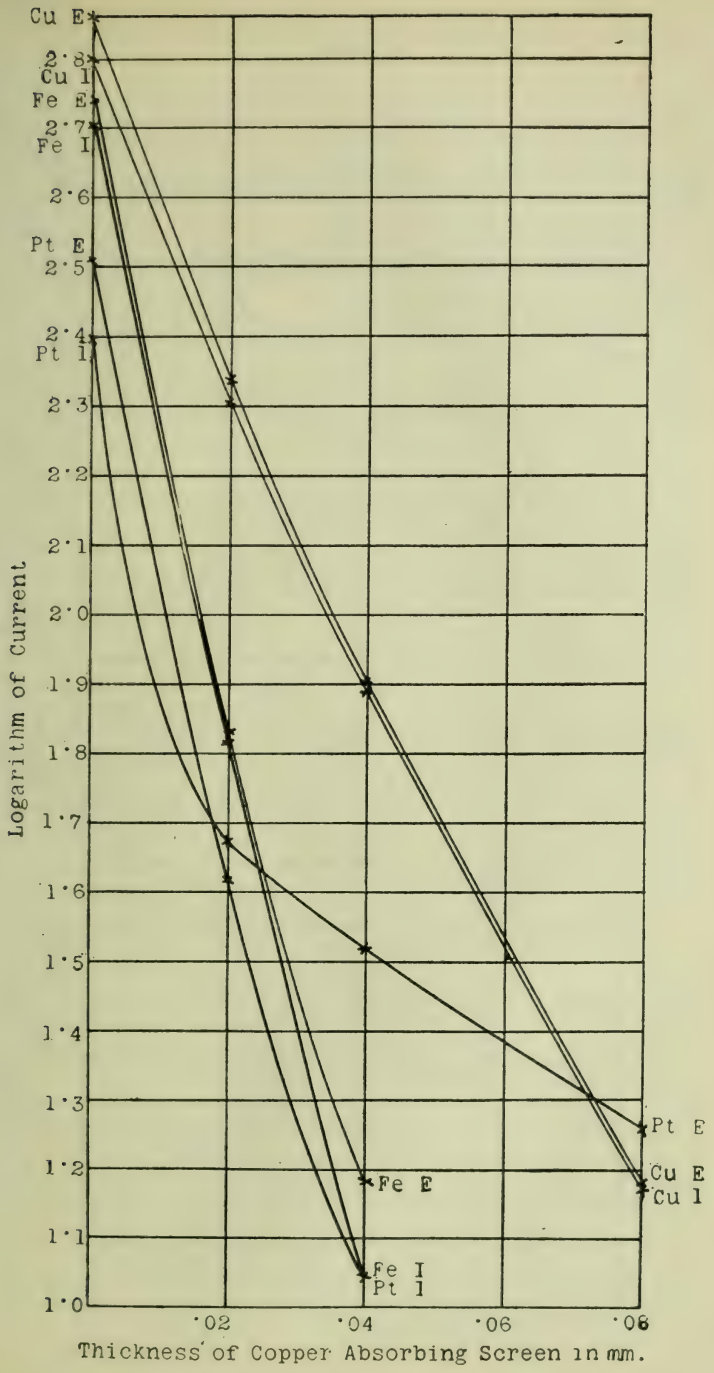
Radiator.	Sn	Cu	Fe	Al
Emergence Current	143	24	23	116
Incidence Current	87	1	0	34

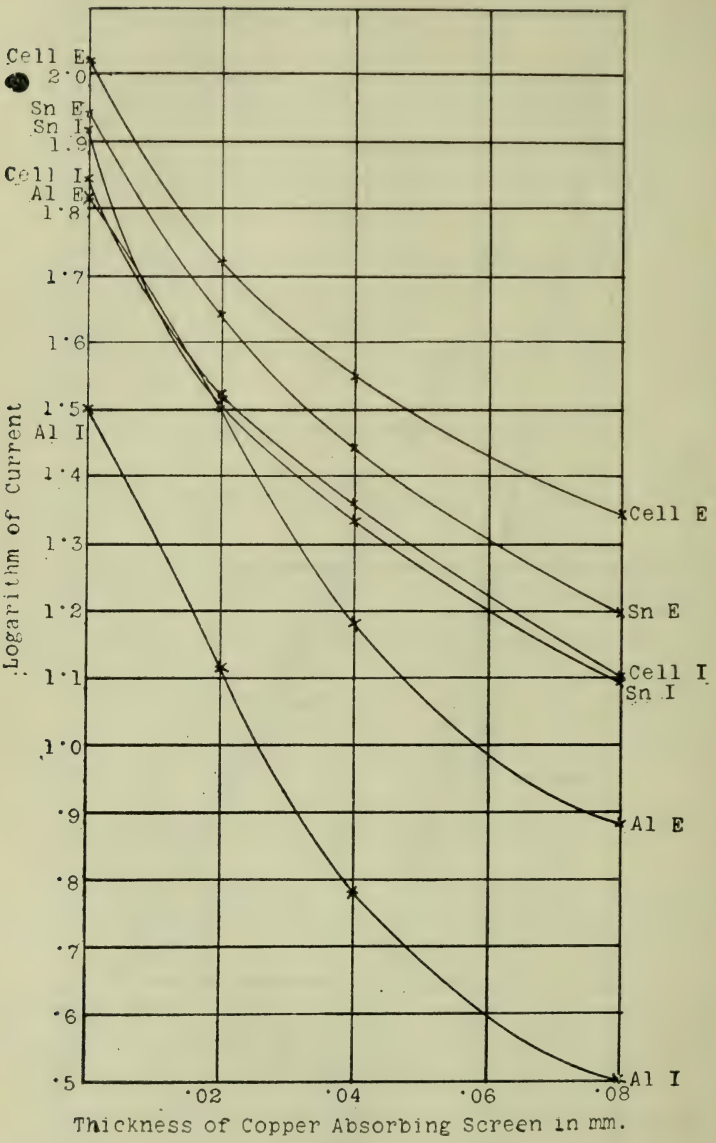
Again, using a copper screen ·002 cm. thick we found: —

Radiator.	Pt	Sn	Cu	Fe	Al	Celluloid.
Emergence Current ...	86	140	361	118	80	138
Incidence Current ...	65	104	364	118	32	93

Putting together a number of results for Cu screens of different thicknesses we obtain the logarithmic curves of absorption shown in the accompanying figures. It should be observed that some of the results thus shown were obtained at different times, so that too much must not be built upon a comparison between them; only the relative positions of the emergence and incidence curves of each substance are sufficiently correct, and the form of each curve as showing the homogeneity or otherwise of the various radiations. One figure shows the emergence (E) and incidence (I) curves for Pt, Cu, and Fe; the other the corresponding curves for Sn, Al, and celluloid.

The experiments described in this paper show that a very marked want of symmetry occurs in the case of secondary X-rays, the emergence rays being generally greater than the incidence. This is another instance of the close parallelism between X- and γ rays. On a material theory of X- and γ rays the effect is easily explained, and is to be classed with the scattering to which β and also, as lately shown clearly by Geiger, α rays are subject. But if the X- and γ rays consist of energy bundles of very small volume, as suggested by J. J. Thomson, then these bundles must be capable of deflection in going through atoms—that is to say, swung out of their paths by the electrical forces to be found within the atoms, just as neutral pairs would be in virtue of their elec-


Cu E
Cu I
Fe E
Fe I
Pt E
Pt I
2·8
2·7
2·6
2·5
2·4
2·3
2·2
2·1
2·0
1·9
1·8
1·7
1·6
1·5
1·4
1·3
1·2
1·1
1·0
Logarithm of Current
·02
·04
·06
·08
Thickness of Copper Absorbing Screen in mm.
Pt E
Cu E
Cu I
Fe E
Fe I
Pt I


Cell E
2·0
Sn E
Sn I
1·9
Cell I
Al E
1·8
1·7
1·6
1·5
Al I
1·4
1·3
1·2
1·1
1·0
·9
·8
·7
·6
·5
Logarithm of Current
·02
·04
·06
·08
Thickness of Copper Absorbing Screen in mm.
Cell E
Sn E
Cell I
Sn I
Al E
Al I

trical fields. It seems hard to understand the distinction between such bundles and entities generally classed as material.

In the course of this investigation we have made a number of experiments on the quantities and qualities of the secondary radiations. This subject has been fully treated by Barkla, some of whose recent papers have not yet reached us, and any discussion we gave might be merely a duplication of part of his enquiry. There is, however, one point to which we should like to refer.

Very hard γ rays follow a density law of absorption, treating all atoms alike, except in respect to weight. Soft γ rays are not independent of atomic groupings of matter, and are far more strongly absorbed by heavy atoms than by light after allowance has been made for weight. The same is generally true of X-rays; but in the case of very soft X-rays there is a tendency to revert to the density law again. For instance, X-rays that have passed through the glass of the bulb are soft to copper, silver, tin, and so on, but hard to aluminium, carbon, and low atomic weight generally. No doubt those rays which are soft to such light atoms have already been absorbed by the glass. But secondary X-rays from most substances are softer than anything emerging from the bulb and contained in the primary ray. The difference is not very great when the absorption is measured with the aid of screens made of substances of the higher atomic weights, because to these the primary rays are soft already. But if the screens are made of aluminium, still more of filter paper, the difference now seems to be very great, for the secondary rays are soft even to low atomic weights. For example, in one experiment a sheet of copper weighing ·018 gr. per square cm. caused a drop of ·401 in the logarithm (to base 10) of the primary rays, and only of ·447 in the case of the emergence secondary rays from copper, of ·645 in the case of platinum rays, and ·805 of iron rays. But when four filter papers weighing ·02 gr. per square cm. were used as screen, the drop in the case of the primary rays was ·010—only one-fortieth of the drop caused by a copper screen of nearly equal weight. In the case of the secondary rays, however, the same screen caused a drop in the case of copper rays of ·100, platinum rays ·053, and iron rays of ·188—that is to say, for these soft rays the filter papers are much more nearly on an equality with copper, weight for weight, than they were for hard rays. It is interesting to bear this in mind when considering the very large quantities of secondary ionization which some substances seem to give. The ionization is always measured in air, which of course consists of atoms not very different in

weight from those contained in filter papers. Consequently primary rays, and secondary rays which differ very little from the primary, are very penetrating to air, and cause relatively small ionizations therein. But secondary rays from Cu and Fe are softened so much as to bring them within reach, so to speak, of air, which rapidly converts them into cathode rays, so that there is a very large ionization. For the cathode rays produced from these secondary rays have probably but little less energy than those produced from the primary; the speed of the cathode ray does not differ very greatly with the penetration of the primary X-ray, so far as experiments have shown. The very large secondary radiations, which some substances appear to give, therefore owe their magnitude largely to the fact that the air in which they are measured is sometimes ten to twenty times as favourable to them as to the primary rays which produced them. In this way we may account to some extent for the startling results obtained by Crowther in the case of arsenic and bromine ("Phil. Mag.," Nov., 1907).

Descriptions of New Australian Hesperiadæ.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read October 6, 1908.]

The following insects are here described in order to allow them to be figured in Messrs. Waterhouse and Lyell's work on the Australian *Lepidoptera* to be published early next year.

I intend to revise the whole of the Australian *Hesperiadæ* next year, and will then supplement my remarks on the family.

Hesperilla polysema, n. sp.

♀, 36 mm. Head, thorax, and abdomen dark-fuscous. Palpi whitish (antennæ broken). Legs dark-fuscous (imperfect). Forewings elongate, moderate, costa slightly arched at base, thence straight, termen rounded, oblique; dark-brownish-fuscous, somewhat shining; markings white, faintly ochreous-tinged; a moderate cuneiform spot in end of cell; ovoid spot lying on vein 1, just before tornus; a moderately large, round spot lying between veins 2 and 3, at about $\frac{3}{4}$ from base of wing; a smaller, but similar spot immediately above; a row of three moderate subcostal spots, placed obliquely, at $\frac{3}{4}$ from base; 2 small rounded spots, one above the other, below and just beyond the 3 subcostal spots; cilia whitish or white, barred with fuscous at extremities of veins. Hindwings with termen round; colour as in forewings, but without markings; cilia as in forewings. Underside:—Colour as above, but all margins minutely irrorated with ochreous scales; markings of upperside reproduced in whitish, an additional small fleck just above spot on vein 1. Hindwings as forewings, excepting that the whole of the wing is minutely irrorated with ochreous scales; markings white, edged with fuscous: an irregular spot in end of cell; a round spot just below middle of vein 8; an irregularly-curved series of seven spots at about $\frac{2}{3}$ from base; upper one smallest, round; 1st, 2nd, and 4th slightly nearer to base than the remainder; 4th, 5th, and 6th somewhat elongate, others rounded; cilia of both wings as above.

Not very near any other known Australian species, but approaches *atralba*, Tepp. The type being a ♀ does not admit of its being placed in its correct genus; it may possibly be a *Trapezites*.

Chillagoe, North Queensland. One specimen; taken in February, by Mr. F. Dodd.

Type in Coll. Lyell.

Hesperilla leucostigma, M. and L., *var.* parasema, *nov. var.*

Having received further specimens of this species I think it advisable to give the Northern form a varietal name as above. It differs from the typical *leucostigma* by the absence in both sexes of the cellular spot, or at the least very faintly indicated. I have not met with intermediate forms.

All the specimens under review were taken at Cairns and Kuranda, Queensland.

Type in Coll. Lower.

Hesperilla tymbophora, M. and L.

♀, 32 mm. Head, palpi, antennæ, thorax, and abdomen dark-fuscous, palpi whitish beneath, antennæ annulated with ochreous beneath, thorax and abdomen clothed with fine ochreous hairs. (Legs broken.) Forewings elongate, moderate; costa slightly arched at base, thence straight; termen bowed, oblique; dark-fuscous, with purple reflections; basal hairs dull-orange; markings pale-yellow; a moderate spot in end of cell, indented on either side; a moderate quadrate spot at base of veins 2 and 3; a smaller and more elongate spot immediately above and slightly beyond; a subcostal series of 3 small dots placed obliquely at $\frac{3}{4}$ from base; cilia deep-dull orange, barred with black at extremities of veins. Hindwings without markings; colour and cilia as in forewings. Underside of both wings dull-fuscous, more or less minutely irrorated throughout with yellowish, especially hindwings; markings of upperside reproduced on forewings, hindwings with a very obscure curved series of 3 or 4 dull-ochreous spots at $\frac{2}{3}$ from base.

Mount Kembla, New South Wales. One specimen.

Type in Coll. Waterhouse.

Hesperilla monotherma, Low.

Telesto monotherm, Low. T.R.S.S.A., p. 169, 1907.

I think it better to regard this species as the Northern form of *ornata*, Leach. The name is misprinted *monotherm*.

Telicota brachydesma, n. sp.

♂, 28 mm. Head, palpi, thorax, and abdomen dark-fuscous, more or less densely clothed with orange hairs, palpi beneath dull-orange or yellow. Antennæ dark-fuscous. Legs

dull-orange, somewhat infuscated. Forewings elongate, moderate; costa nearly straight, termen oblique, hardly rounded; dark-brownish-fuscous, with orange markings; a rather thick costal streak from base to middle of cell, leaving extreme costal edge fuscous; cell filled in with orange; 3 narrow cuneiform interneural subcostal streaks at $\frac{4}{5}$; between these and costal streak are 3 more very narrow interneural streaks, only separated by veins; 5 somewhat quadrate spots, placed obliquely, 1st, lying close to stigma, between veins 1 and 2, narrower than two following; 2nd, immediately above, lying between veins 2 and 3, slightly indented on outer edge; 3rd, immediately above second, somewhat cartridge shaped; 4th and 5th, immediately above and touching the cuneiform subcostal streaks, the whole forming a continuous band, a patch of dull orange lying on vein 1 from base to stigma, somewhat suffused at extremities; a moderate dorsal streak from base to extremity of first of 5 spots; stigma blackish, entire, very narrow, about $\frac{1}{2}$ mm., oblique, extending from vein 1 to vein 4, edged on either side with blackish; cilia black, around tornus becoming orange. Hindwings with termen moderately rounded, somewhat prominent at tornus, colour as in forewings; basal hairs dull-orange; a small roundish spot at posterior extremity of cell; a moderate orange submedian band, edges somewhat crenulate, extending from vein 1 to vein 6, continued on vein 1 as a fine streak nearly to termen and more broadly towards base of wing; cilia orange. Forewings beneath dull-orange, markings of upperside except stigma reproduced; the 5 spots edged on either side narrowly with black; dorsal half of wing blackish; basal third of cell blackish. Hindwings dull-reddish-orange; markings of upperside obscurely reproduced; submedian band edged narrowly on either side with black; an elongate pale-yellowish cuneiform streak filling up space between veins 1 and 2; dorsum broadly blackish, with some orange ferruginous scales near tornus.

♀, 32 mm. Head, etc., as in ♂; forewings dark-brownish-fuscous, somewhat purplish-tinged; markings, except stigma, as in ♂, *subcostal and cellular marks absent*; 3 narrow interneural streaks hardly traceable in some specimens; cilia as in ♂. Hindwings with colour as in forewings; cellular spot not indicated; submedian band more irregularly edged than in ♂, and inclined to be separated by veins; cilia as in ♂.

This insect, which can immediately be separated from its congeners, is at once known by the *very narrow stigma and abbreviated postmedian band*. It is nearest *bambusæ*, Mre.—in fact, I am strongly inclined to think that it may possibly represent the Australian form of that insect. It approaches

augias, Linn., but the postmedian band is never continued along the veins as in that species.

Kuranda and Cooktown, Queensland; six ♂ and one ♀; taken in March and April.

Types in Coll. Waterhouse.

Telicota eurychlora, n. sp.

♂, 32 mm. Head, thorax, and abdomen dark-fuscous, densely clothed with greenish-yellow hairs, palpi ferruginous yellow; beneath whitish-yellow. Antennæ fuscous, annulated with whitish, club beneath orange, apiculus well developed. Legs orange-yellow. Forewings elongate, triangular, costa straight, termen oblique; dark-brownish-fuscous, with orangé-yellow markings; a broad costal streak from base to end of cell, intersected by veins on posterior half, and leaving costal edge narrowly fuscous; whole of cell filled in with orange-yellow; 3 narrow cuneiform interneural subcostal spots, posterior edges excised, at $\frac{4}{5}$ from base, lying between veins 6 and 9, placed obliquely; an oblique series of 5 quadrate spots at $\frac{3}{4}$ from base, reaching from vein 1 to vein 6, all excised on either side, 2 upper small, lower 3 rather large; a moderately thick dorsal streak from base to $\frac{3}{4}$; a patch, scales, and hair lying above vein 1, from base nearly to stigma; stigma narrow, fuscous, oblique, from vein 1 to vein 4, bisected by veins 2 and 3, edged posteriorly by dark-fuscous; cilia dark-fuscous, becoming ochreous-orange around tornus. Hindwings with termen rounded, slightly prominent at tornus; colour as in forewings; markings orange-yellow; dorsal and basal hairs orange-yellow; an ovoid spot in posterior end of cell; a rather broad postmedian band extending from vein 1 to vein 6, lower edge crenulate, upper edge irregular, continued as a fine streak along vein 1 to termen, sometimes a small elongate spot just above vein 6; cilia orange, becoming fuscous towards costa. Underside of forewings dull-orange-yellow; markings of upperside, except stigma, reproduced; basal third of cell dark-fuscous; dorsum fuscous throughout; posterior edges of lower 2 quadrate spots suffusedly edged with dark-fuscous. Hindwings dull-orange-yellow, with a somewhat greenish tinge, markings of upperside faintly reproduced in dull-orange; an elongate cuneiform streak of rather bright-orange lying between veins 1 and 2.

♀, 32 mm. Head, etc., as in ♂; markings as in ♂, but ground colour darker; subcostal markings suffused with fuscous, anterior half of cell filled with ground colour, the 3 large quadrate spots less excised at edges. Hindwings as in ♂. Underside of both wings as in ♂, but more tinged with dull-greenish-yellow.

This species is easily recognized by the colouration and absence of markings of hindwings. It is nearest *augias*, Linn., but is a much larger insect, and although *augias* shows some geographical range of variation it does not approach the species under notice so as to be confused with it.

Ballina, New South Wales (Richmond River); taken in February. Mr. Waterhouse informs me that so far as he knows this species is confined to the above district.

Types in Coll. Waterhouse.

ERYNNIS TRICHOPEPLA, n. sp.

♂ ♀, 38-46 mm. Head, palpi, thorax, and abdomen bright-orange-yellow; palpi and thorax beneath pale-yellow; posterior segments of abdomen ringed with blackish above, beneath wholly yellow. Antennæ dark-fuscous, club reddish-yellow. Legs bright-yellow. Forewings elongate, triangular, *costa straight*, termen oblique, gently rounded; blackish-fuscous, with bright-orange markings; a broad costal streak, leaving extreme costal edge fuscous, from base posterior extremity of cell, intersected by veins at posterior extremity; cell filled in with orange, except a small patch at posterior extremity; 3 obliquely-placed elongate cuneiform spots between veins 6 and 9, posterior extremity excavated and finely continued along both edges of veins to termen; an oblique series of 5 somewhat quadrate spots from vein 1 to vein 6, posterior edges strongly excised and continued as fine lines along both edges of veins, nearly or quite to termen, excisions filled in with black, anterior edges of 5 spots irregularly crenulate; a broad dorsal streak from base to beneath middle of 1st quadrate spot; an elongate patch of hairs lying on vein 1 near base; cilia orange, strongly mixed with fuscous on upper half of termen. Hindwings with termen rounded; tornus prominent; colour as in forewings; markings orange; a moderately large tuft of orange-yellow hairs springing from base of vein 7; vein 1 similarly haired from base to posterior edge of postmedian band; an ovoid spot in posterior extremity of cell; a rather broad postmedian band, edges irregularly crenulate, extending from vein 1 to vein 7, broadest on vein 1, where it is continued as a fine line to termen and more thickly to base; cilia orange-yellow. Underside orange-yellow, distinctly mixed with greenish, especially along termen; markings of upperside reproduced in orange; *basal* third of cell blackish; a series of 7 well-defined black spots at posterior extremities of apical and quadrate spots, 4th and 5th spots also edged anteriorly by a small black spot; dorsum and wing below vein 1 wholly black. Hindwings pale-greenish-yellow; markings of upperside reproduced in pale-orange;

cellular spot edged posteriorly with black: postmedian band edged on either side with well-defined black spots; a large roundish black patch edged with orange at tornus.

The sexes do not differ except in size.

We (Meyrick and Lower) formerly called this insect *palmarum*, Mre. (T.R.S.S.A., p. 110, 1902), but the true *palmarum* of Moore is, so far as I know, not found in Australia.

An idea prevalent amongst some of my *confrères* that this insect is *Olivescens*, of Herrich-Schæffer, but his figure and especially the description certainly *do not* apply to this insect; but I shall reserve my criticisms until I revise the group.

Mackay, Townsville, Queensland: nine specimens; taken in February and March.

Types in Coll. Lower.

Apaustus hetero bathra, n. sp.

♂ ♀, 20-24 mm. Head and thorax dark-fuscous, thorax clothed with yellowish hairs, palpi fuscous, mixed with orange, beneath yellow. Abdomen dark-fuscous, more or less densely clothed with orange, sometimes showing segmental rings, beneath wholly yellow. Antennæ dark-fuscous, annulated beneath with yellow; club of ♂ beneath yellow, apiculus black; club of ♀ black, apiculus black. Legs yellow. Forewings elongate, triangular; blackish-fuscous, with orange markings; a broad costal streak, from base to posterior extremity of cell; cell filled in with orange; a confluent patch (indicating the usual 3 subapical spots) beneath costa at $\frac{3}{4}$; an oblique of 5 quadrate spots extending from vein 1 to vein 6, 2 upper small, and meeting the apical patch, 3 lower very much larger, with irregular edges; cilia black, becoming orange around tornus. Hindwings with termen rounded; colour as in forewings, basal and dorsal hairs yellow; markings orange; a small spot at posterior extremity of cell; a moderately broad, postmedian band, edges, somewhat crenulate from vein 1 to vein 6, continued along vein 1 almost to base; cilia yellow, orange at base. Underside of forewings with area along termen greenish-yellow; markings of upperside reproduced in orange, dorsum and wing below vein 2 blackish; basal half of cell black. Hindwings yellowish-green; markings of upperside reproduced in orange; cellular spot edged posteriorly with black; postmedian band edged on either side with narrow black lunules; a blackish elongate streak along dorsum, becoming blotch-like at termen.

Differs from its Australian congeners by the absence of stigma in ♂; the club of the antennæ affords a fairly accurate guide in the determination of the species, but until we

are in possession of more material from other localities I would not insist on this character being of any specific value; but in the other species of the genus known to me the club of the ♀ on underside is *yellow*, as is also the ♂.

Mackay, Cairns (Kuranda), Cooktown, and Cape York; twenty-five specimens: taken between February and April.

The species show no variation.

Types in Coll. Lower.

LIBYTHEIDÆ.

Libythea geoffroyi, Godt.

By an unfortunate error I confused the sexes of this species when commenting (T.R.S.S.A., p. 169, 1907) on the same. The ♂ is the lilac-blue form, the ♀ is tawny-yellow. My former remarks were *vice versa*.

New Australian Tortricina.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read October 6, 1908.]

TORTRICIDÆ.

Capua epipepla, n. sp.

♂, 14 mm. Head, palpi, and thorax pale-ochreous. Antennæ whitish. Legs ochreous-whitish. Forewings elongate, moderate, costa arched, termen nearly straight; 7 and 8 long-stalked; pale-ochreous, irregularly strigulated with fuscous-ferruginous, and with fuscous-ferruginous markings; costal fold rather broad, dull-ochreous; basal patch obsolete, only indicated by a small patch of apparently raised scales on dorsum at $\frac{1}{3}$; median patch rather narrow, very oblique from middle of costa to middle of wing, thence becoming confused and blotch-like, terminating just above tornus, below which the ground colour is mixed with ferruginous-fuscous; a moderate, somewhat triangular costal patch, from $\frac{3}{5}$ costa to apex, lower edge terminating on middle of termen; between this and median patch is a thick streak of ground colour, which becomes a quadrate spot on costa: an extreme apical streak of ground colour. Hindwings whitish-ochreous, darker posteriorly; cilia pale-ochreous.

Cooktown, Queensland. One specimen; in November.

Capua (?) tripselia, n. sp.

♂, 14 mm. Head and antennæ fuscous. Palpi ochreous-fuscous. Thorax grey-whitish, with a posterior fuscous quadrate spot. Legs ochreous-whitish, posterior pair paler. Abdomen grey. Forewings rather broad, costa strongly arched, apex obtuse, termen bowed; pale-grey-whitish, irrorated throughout with fine fuscous strigulæ; markings well defined; brownish-ochreous; outer edge of basal patch from beyond $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum, becoming blotch-like on lower half and containing a dull leaden spot immediately above dorsum; anterior edge of median patch from before middle of costa to middle of dorsum; posterior edge from middle of costa, thence very obliquely curved to tornus, causing the patch to appear narrow on costa, thence rapidly dilated to tornus; a moderately broad, elongate, triangular patch on apical fourth of costa and termen, continued obliquely along termen to above tornus; a narrow streak of ground colour

along termen, from apex to termination of patch; cilia grey-whitish. Hindwings and cilia grey-whitish.

I doubtfully refer this species to *Capua* on account of the form of the palpi, which are somewhat approximated to the face, and veins 7 and 8 of forewings being extremely long-stalked.

Kuranda (Dodd) and Cooktown (Olive). Three specimens; in September.

Polylopha elaphris, n. sp.

♂, 12 mm. Head and palpi white, second joint of palpi beneath at base, sharply dark-fuscous, terminal joint fuscous. Antennæ and thorax fuscous. Abdomen ochreous. Anterior and middle legs whitish, tibiæ irregularly spotted with fuscous, tarsi banded with fuscous; posterior legs whitish-ochreous, tarsi white. Forewings elongate, moderate, costa gently arched, termen straight; surface with raised scales; 7 and 8 separate, both to costa; white, with fuscous markings; three spots on costa, first, smallest, at base; third, largest, at $\frac{1}{3}$; a dull-fuscous shade, thickly irrorated with fuscous and dark-fuscous spots throughout, extending from base along dorsum to just beyond $\frac{2}{3}$, limited on upper edge by cellular vein, on which are placed 3 or 4 dark-ferruginous spots, almost meeting costal spots; a moderately large dark-fuscous spot in middle of wing, resting on upper edge of shade; a broad, irregular fuscous shade along termen, narrowing towards tornus, with a darker-fuscous median shade, which is curved in on termen in middle and there becoming black, thence continued suffusedly to tornus; space between median shade and termen spotted with white; a more or less interrupted ferruginous-fuscous line along termen; cilia dark-fuscous. Hindwings brownish-ochreous; cilia grey, with a fuscous median line.

North Queensland. Two specimens, received from Mr. Dodd; taken in December.

Acanthothyspoda, n. g.

Thorax smooth. Antennæ of ♂ ciliated (1). Palpi moderate, somewhat appressed to face, second joint roughly scaled, terminal joint short, distinct. Posterior coxæ and tarsi clothed with thick spinous scales, forming a dense mass. Abdomen clothed with long, coarse hairs, especially laterally, beneath smooth. Forewings elongate, costa simple, 7 and 8 separate, 7 to termen. Hindwings elongate, trapezoidal, 6 and 7 from a point, 3, 4, and 5 approximated at base.

Type *elæodes*.

A. ELÆODES, n. sp.

♂, 14-15 mm. Head, palpi, and thorax dull-green, palpi tinged with ferruginous. Antennæ ochreous. Abdomen dull-grey, thickly clothed above and on sides with long black hairs (absent in ♀), beneath smooth. Legs blackish, anterior and middle tibiæ banded with ochreous-white, posterior pair wholly blackish, with a prominent thick patch of spine-like scales on coxæ (absent in ♀). Forewings elongate, moderate, costa hardly arched, termen nearly straight, hardly oblique; pale-dull-greenish, with ferruginous-fuscous markings; wing more or less crossed by waved oblique strigulæ; outer edge of basal patch obscure, from $\frac{1}{6}$ costa to $\frac{1}{5}$ dorsum: median patch rather narrow, well developed, very oblique, from about middle of costa to dorsum just before tornus, barely reaching dorsum in ♀; a moderately large rhomboid patch in middle, just before termen, edged on anterior edge by a fine line of silvery-grey; costa between base and outer edge of basal patch strongly strigulated; costa between outer edge of median patch and apex with three somewhat small quadrate spots, separated by spots of whitish, each containing a minute blackish spot, last of the three costal spots continued as a fine line to middle of termen; a small spot at apex; cilia ferruginous-fuscous, with a blackish basal line.

Cooktown and Cairns (Dodd), Queensland. Two specimens; in October. I have a specimen from New Guinea, which appears to be this species, but not being in the best of condition admits of some doubt.

EPITRICHOSMA, n. g.

Thorax smooth. Antennæ in ♂ ciliated. Palpi moderately porrected, second joint triangularly scaled, terminal joint exposed, short. Abdomen with tufts of lateral hairs posteriorly. Forewings elongate, moderate, with raised scales; costa in ♂ with a patch of more or less curled hairs from base to middle, longer on basal half. Middle and posterior tibiæ roughly haired. All veins separate, 7 to termen. Hindwings with veins 3, 4, and 5 approximated at base; 6 and 7 separate.

Differs from *Acanthothyspoda* by hairy costa and separation of all veins.

Type *neurobapta*.

E. NEUROBAPTA, n. sp.

♂, 14 mm. Head, palpi, antennæ, thorax, and abdomen pale-yellowish-ochreous. Abdomen orange-yellow, with tufts of long yellow hairs, placed laterally on posterior segments. Forewings elongate, moderate, costa gently arched, apex

rounded, termen rounded; costal hairs yellow; pale-yellow. darker towards base; all veins more or less outlined with ferruginous; basal patch obsolete; median patch ferruginous, rather obscure, edges irregularly waved, anterior edge from before middle of costa to middle of dorsum; posterior edge from $\frac{2}{5}$ costa to beyond middle of dorsum; costal edge between posterior edge of median patch and apex with 4 or 5 equidistant ferruginous spots; a fine interrupted line of ferruginous along termen; cilia pale-yellow. Hindwings transparent; pale-greyish, sprinkled with yellow; all veins outlined with orange-yellow; dorsal hairs bright-orange-yellow; cilia grey-whitish, with a yellowish basal line.

Kuranda, Queensland. One specimen; in December.

Leptarthra hemicosma, n. sp.

♂, 12 mm. Head, face, and palpi bright-yellow, basal joint of palpi fuscous externally, crown fuscous-reddish. Antennæ fuscous-reddish. Thorax fuscous-reddish, patagia bright-yellow. Abdomen dark-fuscous. Legs fuscous, tarsi banded with whitish. Forewings elongate, moderate, costa gently arched, apex rounded, termen nearly straight; 3 from angle, 8 and 9 approximated at base; bright clear yellow, costa very finely strigulated throughout with reddish-fuscous; a large reddish-fuscous apical patch, occupying posterior $\frac{2}{5}$ of wing, anterior edge limited by a curved fine waved fuscous line, from costa at $\frac{3}{5}$ to dorsum beyond middle; within the patch are two or three short longitudinal streaks of paler and scattered fuscous strigulations; an interrupted blackish line along termen; cilia light-reddish-fuscous. Hindwings and cilia smoky-brown; cilia with a greyish basal line.

Very like some species of *Chrysoryctis (Tineidæ)*. The approximation of veins 8 and 9 at base I regard as specific only; in all other respects it agrees with *Leptarthra*, Low.

Kuranda, North Queensland. Two specimens; in October (Dodd).

L. metallocosma, Low.

Tortrix metallocosma, Low.

Having obtained further specimens for examination I refer the above to *Leptarthra*.

Dichelia lunifera, n. sp.

♀, 10 mm. Head, palpi, and thorax reddish-fuscous, palpi whitish internally. Antennæ fuscous. Legs greyish, tibiæ and tarsi infuscated. Abdomen grey. Forewings elongate, moderate, costa gently arched, termen oblique: reddish-fuscous, somewhat coppery-tinged; some black scales along

costa; a somewhat lunate black mark in middle of wing; a few black scales along termen; cilia fuscous, mixed with coppery-reddish. Hindwings grey; cilia grey, with a pale-fuscous subbasal line.

This species may be an extreme form of *atristrigana*, Meyr., but the ground colour of that is greyish-fuscous or dark-fuscous, without any coppery tinge, and the markings more complicated.

Broken Hill, New South Wales. One specimen; in November.

TORTRIX EUPLECTRA, n. sp.

♂, 16-18 mm. Head and palpi dull-ochreous-fuscous, palpi paler beneath. Thorax grey, with four indistinct transverse fuscous lines. Antennæ fuscous. Anterior and middle legs greyish, posterior pair silvery-white, all tibiæ and tarsi banded with fuscous. Abdomen greyish-ochreous. Forewings elongate, moderate, costa gently arched, termen nearly straight; smoky-fuscous, more or less finely strigulated with darker; costa strigulated with short oblique white marks, arranged in pairs, the separation being effected by fine lines of ground colour, the one nearest apex is curved outwards and continued to middle of termen, where it meets a similar but narrower streak from costa beyond; outer edge of basal patch irregularly waved, from costa at $\frac{1}{5}$ to dorsum at $\frac{1}{3}$; a broad, fuscous, median patch, edges nearly straight; anterior from middle of costa to middle of dorsum, posterior from $\frac{5}{6}$ costa to tornus, upper $\frac{2}{3}$ much darker, and the 3 pairs of white costal marks within the patch, which are filled with leaden-metallic, are very oblique, and reach $\frac{1}{3}$ across wing, touching each other at termination; ground colour between basal and median patch ochreous-whitish; an elongate streak of dull-ochreous-whitish above tornus; a somewhat rounded spot of similar colour just above, only separated by a bar of darker ground colour; a fuscous line along termen; cilia ferruginous, spotted with darker. Hindwings smoky-fuscous; cilia grey, with a fuscous line at base.

Brisbane and Mackay, Queensland. Two specimens.

GRAPHOLITHIDÆ.

PHRICANTHES MACROURA, n. sp.

♂, 18 mm. Head, palpi, and thorax whitish, palpi and thorax beneath white. Antennæ fuscous. Legs whitish, anterior and middle tarsi banded with fuscous. Abdomen fuscous. Forewings elongate, moderate, costa hardly arched, termen slightly oblique; 7 and 8 separate, both to costa;

white, with brownish-fuscous markings; costa obliquely strigulated throughout with short equidistant marks, posteriorly becoming better defined, the last six separated by whitish ground colour; a more or less interrupted blackish submedian longitudinal streak, darkest on basal third and edged below throughout by its own width with ferruginous-fuscous, extending from base to $\frac{3}{4}$, ground colour above whitish; a patch of pale-fuscous along termen, rather broad at apex, thence curved inwards and rapidly attenuated to tornus; an elongate blackish spot in patch above middle, edged above by a streak of whitish; a small blackish spot on termen above middle; several fine, somewhat dot-like transverse strigulæ on posterior half of wing; a narrow fuscous shade along dorsum; cilia whitish, with a ferruginous median line and some scattered black points. Hindwings fuscous; cilia fuscous, with a paler basal line.

North Queensland. One specimen; in January.

Palæobia peltosema, n. sp.

♀, 12 mm. Head, palpi, and thorax very pale-greenish-white, palpi beneath whitish. Antennæ pale-greenish-white, fuscous-tinged. Abdomen greyish-fuscous. Legs whitish, anterior and middle tarsi banded with fuscous. Forewings elongate, moderate, costa hardly arched, termen rather strongly sinuate beneath apex, apex somewhat produced; pale-greenish-white, finely stigulated throughout with light-fuscous, paler towards base of costa; costa obliquely strigulated with short fuscous marks; a rather large triangular fuscous patch on costa, extending from just beyond middle and continued nearly to apex, apex of patch reaching nearly $\frac{3}{4}$ across wing; in the patch are 4 or 5 small oblique pairs of whitish marks; a fine fuscous, interrupted line along termen; cilia greyish-fuscous, with a sharp tooth of fuscous at apex, being the continuation of the triangular patch. Hindwings thinly scaled; pale-fuscous; cilia grey, with a fuscous subbasal line.

Mackay, Queensland. One specimen: in November.

Strepsiceros lasiophora, n. sp.

♂ ♀, 16 mm. Head, palpi, antennæ, and thorax dark-brownish-fuscous, palpi paler internally and beneath. Abdomen pale-fuscous. Anterior and middle legs fuscous, tarsi banded with white, posterior legs whitish, banded with fuscous. Forewings elongate, moderate, rather narrow, termen nearly straight, hardly oblique. Costal fold of ♂ rather broad, extending from base to near middle, and containing a large tuft of ochreous wool-like hairs; brownish-fuscous,

darker in ♂, and irrorated with dull leaden metallic scales, more or less arranged in transverse series; costa shortly and obliquely strigulated with dark-fuscous; various irregular dark-fuscous transverse lines; an irregular patch of pale-fuscous in middle of wing (absent in ♀); a somewhat triangular patch of dark-fuscous on dorsum near tornus; a small fuscous spot on costa near apex, from which proceeds a narrow waved transverse line of same colour to dorsum, at tornus edged on either side by a dull leaden metallic line; a second, similar, but more distinct waved line, from a fuscous spot at apex, along termen; cilia dark-fuscous on upper $\frac{2}{3}$, pale-fuscous below, mixed throughout with leaden metallic points. Hindwings 3 and 4 stalked, 5 widely remote from 4; 6 and 7 separate; thinly scaled, fuscous, paler towards base.

Very closely allied to *Macropetana*, Meyr., but apparently distinct by the large costal tuft and absence of three sharply-defined black streaks above tornus, which are rarely absent in that species.

Townsville, Queensland. Five specimens; in March (Dodd).

The Strength of South Australian Timbers.

By Professor R. W. Chapman, B.A., B.C.E.

[Read October 6, 1908.]

The only previously recorded tests upon the strength of South Australian timbers are some carried out by Professor Warren at the University of Sydney, and chronicled in his book on "Australian Timbers," published in 1892. These tests were on specimens of Sugar Gum, Blue Gum, Box, and Red Gum, supplied by the South Australian Conservator of Forests. Although unfortunately we have not in this State timber for export, it is very desirable that we should have a knowledge of the properties of the timbers indigenous to the country, and during the year some 200 tests upon the mechanical strength of South Australian timbers have been made at the University on specimens supplied by Mr. Gill, Conservator of Forests. The following timbers are represented: —

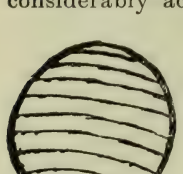
Botanical Name.	*Colloquial Name.*
Eucalyptus rostrata	Red Gum
,, *fasciculosa*	Pink Gum
,, *obliqua*	Stringy Bark, Messmate
,, *vimmalis*	Manna Gum, White Gum
,, *leucoxylon*	Blue Gum
,, *rubida*	White Gum, Candle Bark
,, *hemiphloia*	Box Gum
,, *odorata*	Peppermint Gum
,, *cambagei*	Bastard Box
,, *capitulata*	Stringy Bark, Messmate
,, *corynacalyx*	Sugar Gum
Pinus insignis	

All of these are indigenous to South Australia, with the exception of *Pinus insignis*.

Most of the timber came either from Kuitpo or Wirrabara, and was sent in pieces about 7 ft. long and 6 in. by 4 in. The greater part of it came in a fairly green state in July, 1907. A few tests were made soon after its arrival, but most of it was stacked in the laboratory and no further experiments made until February this year. As the summer was hot and dry the timber, especially small pieces cut ready for testing, became well dried by the time the strength tests were made. The timber contained a percentage of moisture (estimated on the weight of the dry wood) ranging from 20

to 50 per cent. on arrival, but by February this had decreased in the smaller specimens to 10 or 12 per cent. The moisture in the smallest pieces has not gone below 9 per cent.

During the process of drying the timber contracted very considerably across the grain. The amount of this contraction was measured on a number of pieces that had been turned to a cylindrical form in the lathe in July, 1907. By February, 1908, instead of being round, the section of every one was an oval, as shown rather exaggerated in the figure. Contraction had taken place in both directions, but much more in the direction parallel to the rings than in the direction at right angles to them. The average results of a number of such measurement were as follow:



Timber.	Percentage of Moisture Compared with the Dry Weight.		Percentage of Contraction in terms of Original Diameter.	
	On July 7, 1907.	On Feb. 18, 1908.	Parallel to Rings.	Radial to Rings.
Red Gum ... ... (*E. rostrata*)	37	9	5·6	2·5
Stringy Bark ... ... (*E. obliqua*)	22	11	7·8	2·1
Pink Gum ... ... (*E. fasciculosa*)	25	10	4·3	2·5
Blue Gum ... ... (*E. leucoxylon*)	26	13	6·2	1·6
Manna Gum ... ... (*E. vimmalis*)	50	12	10·3	2·5
White Gum ... ... (*E. rubida*)	24	11	6	1·7

The contraction was of a very different character in different woods. With Pink Gum and Blue Gum, for example, it was very uniform, and the wood remained smooth and even. But with Red Gum the different rings of growth appear to contract very unevenly, with the result that the specimens became marked with longitudinal ridges. This wood warps badly, as do also Manna and White Gum.

The weights of specimens of those woods that had been stored in the laboratory for over twelve months, and contained about 12 per cent. of moisture, averaged as follow: —

Timber.	Weight in Pounds per cubic foot.
Pink Gum	70·5
Red Gum	51
Manna Gum	52·9
Bastard Box	65·8
Stringy Bark	54·3
Sugar Gum (matured) ...	70·7
Peppermint Gum ..	70·8
Box Gum	66·8
Blue Gum	58
Rubida (White Gum) ...	60·5

The amount of moisture contained in timber has a great influence upon the strength. The more moisture the timber contains the weaker it is, as has been clearly shown by the experiments conducted by the United States Forestry Department, and this is equally true, whether the moisture is the natural sap or is water absorbed. The experiments carried out by Mr. Julius on behalf of the Western Australian Government have shown that the same is true for our Australian timbers. It thus becomes important in chronicling the results of tests upon timber that the percentage of moisture should be determined for each specimen, in order that comparisons may be of value. Accordingly, such determinations were made for most of the pieces tested. A thin section was cut out across the test piece, near the place where fracture occurred, within twenty-four hours of the experiment. This section was weighed and then placed in a drying-oven, where it was kept at a temperature of 115 deg. Cent. for four hours, when it was again weighed. Experiments showed that it was unnecessary to keep it in the oven more than four hours to get a determination sufficiently close for the purpose, as a longer period of drying made a difference of only 1 per cent.

The experiments were made with a Riehlé screw-testing machine, capable of exerting and measuring forces up to 100,000 lb., and each timber was subjected to five different classes of tests—I., Transverse strain to determine its strength as a beam: II., direct tension: III., shearing along

the grain; IV., compression along the grain; V., compression across the grain.

I.—Beam Experiments.

The timbers used for these tests were a little over 6 ft. long, the depths of the beams ranging from $3\frac{1}{2}$ to $5\frac{1}{2}$ in. In most cases the supports were placed uniformly 70 in. apart, and the beams were loaded at the middle so that the deflection was produced at the rate of $\frac{1}{8}$ in. per minute. On one side of the beam at the middle a vertical engraved scale of polished nickel was tacked. Across the front of this was stretched a fine thread, stretched with a piece of elastic between two small nails placed half-way up the beam, directly over each support. As the polished nickel acted as a mirror the position of the thread on the scale could be read with great accuracy.

The amount of deflection produced by a load on a timber beam depends upon the time that the load remains on the beam, even when the load is only a small proportion of that which is required to break the beam. As a consequence the modulus of elasticity deduced from experiments in a testing-machine, where the load is increased gradually and continuously, is likely to be much higher than should be reckoned on in practice when computing the deflection of a beam under a load that is likely to remain on for a considerable time. The curve shown in fig. 1 illustrates the result of an experiment on a beam of Sugar Gum, taken from a tree twenty-nine years old. The beam was $3\frac{1}{2}$ in. wide, $3\frac{3}{4}$ in. deep, with a span of 70 in. Its ultimate breaking load in the centre was 4,180 lb. This beam was loaded with 1,960 lb., and the deflection was ·67 in. This deflection was now kept constant, and the load required to produce it was measured at intervals. At the end of six minutes the load had dropped down to 1,900 lb. In one hour it was only 1,830 lb. In twenty-four hours it was down to 1,615 lb., and at the end of three days, when the specimen had to be removed from the machine to make room for other experiments, the load required to produce this deflection of ·67 in. was only 1.510 lb. Similarly, when a constant load is allowed to remain on a beam for any considerable time, the deflection produced continually increases. So in using the ordinary tabulated values of the modulus of elasticity for computing the amount of deflection of a beam under practical loadings, allowance must be made for this time effect, and the actual value used for the modulus of elasticity should not be more than half the usual tabulated value as deduced from the ordinary tests.

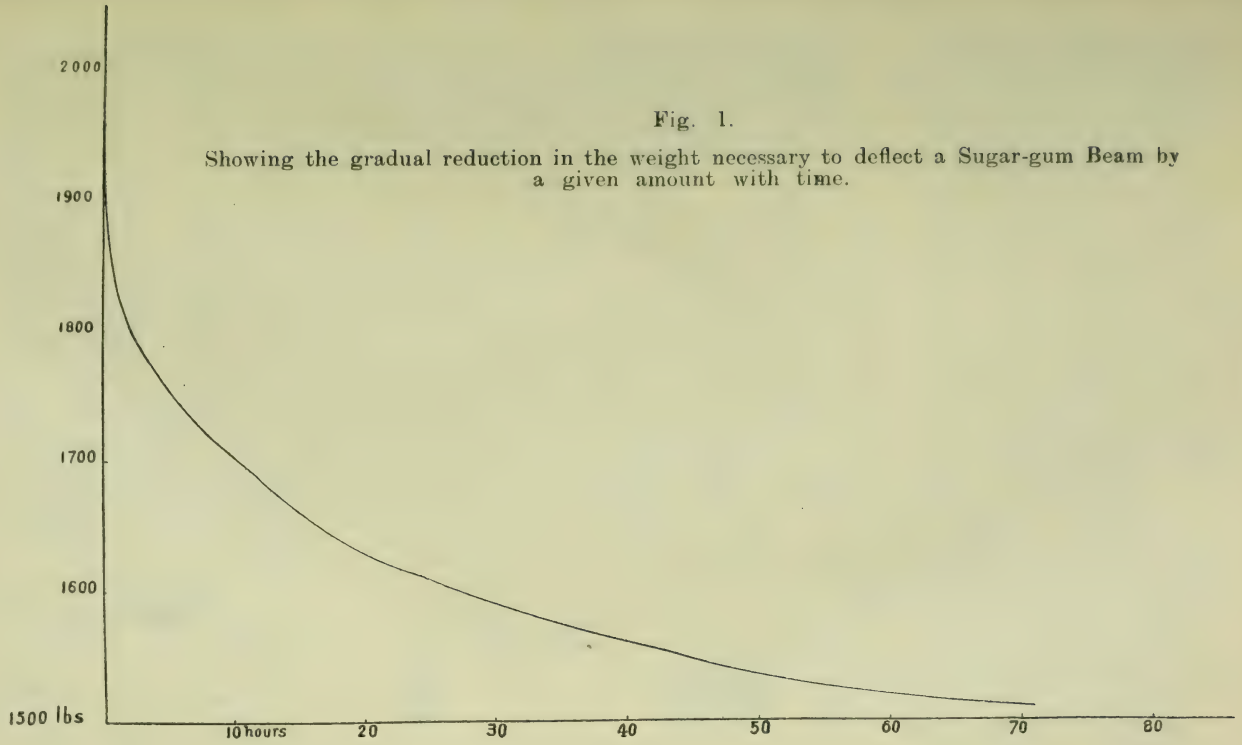


Fig. 1.

Showing the gradual reduction in the weight necessary to deflect a Sugar-gum Beam by a given amount with time.

II.—Tension Tests.

The strength of most woods under direct tension is so high compared with its strength in other ways, that wood seldom fails in this manner in actual structures, and so these tests are not of such practical importance as the others. A number of tests were made upon specimens turned in the lathe to a diameter of about $1\frac{1}{4}$ in., the length of the specimen being 22 in. over all and 10 in. inside the grips. The stretching of the wood under tension was measured between two points, originally 8 in. apart, by means of a Goodman extensometer, enabling measurements to be made to the $\frac{1}{10000}$ of an inch, and from these readings the modulus of elasticity was computed.

III.—Shearing Along the Grain.

Fig. 2.
Form of Test Piece for Shearing Experiments.

The failure of wood by shearing or detrusion along the grain is one of the commonest methods of failure in actual structures, but the determination of the shearing strength depends a good deal upon the way in which the experiments are made. The method adopted is the standard method in the United States Forestry Department. The test piece is cut in the form of a block 2 in. square and 16 in. long (as shown in fig. 2). This is pierced by two morticed holes, each $\frac{1}{2}$ in. wide and 2 in. deep, one at each end of the block in directions at right angles. The block is held by a bolt passing through the centre. A steel key, $\frac{1}{2}$ in. wide, is passed through each mortice in turn, and pulled until it forces out the wood at the end of the mortice. In order that the key may press evenly over the wood a small steel bearing piece is fitted into the bottom of the mortice; this has a curved back upon which the steel key presses.

When the mortice cuts across the rings of growth at right angles the shearing resistance is much less than when the direction of the mortice is parallel to the rings. In the tables appended, however, the average results are given.

IV.—Compression Along the Grain.

Tests were made upon blocks 8 or 12 in. long, cut off the uninjured ends of the beams after they had been broken at the centre. The ends were cut off square in a lathe and the blocks subjected to compression along their length. Failure occurred in every case by the fibres buckling over along a plane inclined to the axis of the block, the greatest slope of this plane being always parallel to the rings. In this test the whole of the fibres of the test piece are subjected to a uniform stress, and the test is regarded by some experimenters as the best test for comparing the strengths of timbers.

V.—Compression Across the Grain.

For this test blocks 8 in. long were used and 3 to 4 in. thick. Each block was laid on its side on the table of the testing-machine and subjected to compression by means of a castiron block 4 in. wide, reaching across the whole width of the specimen. There is no definite stress at which failure occurs in tests of this nature, and the general method is to record the stress at which the iron block crushes into the wood—first to an amount of 3 per cent., and secondly to an amount of 15 per cent. of the depth of the specimen.

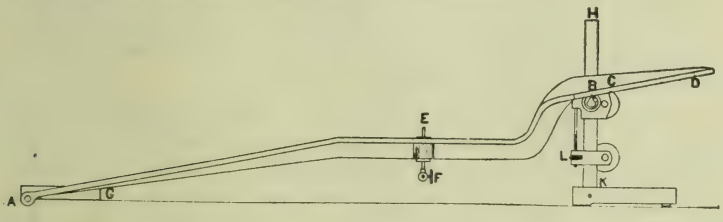


Fig. 3.
Apparatus for Measuring in Cross-compression Tests.

For this purpose the apparatus illustrated in fig. 3 was devised. AD is a stiff metal arm turning freely about a pin at A, supported on the block G, that rests on the edge of the table. A vertical insulated pin, EF, passes through the middle of the arm, being free to move downwards through the arm, but is pressed upwards by a strong spiral spring. It is tipped with platinum at the top, E, and a wire can be attached at F. The pin at A rests beyond the edge of the table; its centre is on the same horizontal plane as the surface of the table, and also in a straight line with E and three nicks, B, C, D, on the underside of the arm. The dis-

tances, AB, AC, and AD, are, respectively, 20·61, 21·25, and 24·25 in. A vertical support, HK, rests on the table and carries a knife-edge which can fit into any one of the nicks, B, C, or D, and its height can be finely adjusted by the screw L. When the specimen is placed on the table ready for testing, this apparatus is placed alongside and parallel to it. An electric battery is connected up to F and also to a binding screw attached to the castiron plate that is to crush into the specimen. In the circuit is an electric bell. The knife-edge supported by HK is then placed in the nick B, and the height of the arm adjusted until E makes contact with the underside of the castiron plate. As soon as contact is made the bell rings, and the position can be adjusted very accurately. Then the knife-edge is moved out until it rests in the nick C. This lowers E exactly 3 per cent. of its original height, whatever that may have been. The machine is now set to work until the plate crushes down so as to again make contact with E, when the bell rings and the record is taken. HK is then slid back till the knife-edge rests in the nick D, and this lowers E exactly 15 per cent. of its original height. Crushing again proceeds until contact is made once more and the bell again rings.

The results of the experiments so far made are given in the tables that follow. For purposes of comparison the average results of tests upon American Oak are given at the bottom of each table, quoted from Professor Johnson's work on "Materials of Construction."

The experiments made are not sufficiently numerous to enable fair general average values of the strengths to be deduced, but are given as the first instalment of what it is hoped to make a much more complete series of tests, to be carried out as opportunity offers. It is of obvious importance that we should have as complete a knowledge as possible of the properties of our local timber in order to decide upon what trees to grow for the extensive schemes of replanting forest trees that must be undertaken in the future. The specimens of the Pink Gum *(Eucalyptus fasciculosa)* that have been sent to me are magnificent timber, and, so far as I know, no other tests have been made upon this species. In every form of test it gave splendid results, and the timber is remarkably dense and uniform. The specimens of Sugar Gum, taken from matured forest trees, also gave very fine results, although the timber is not of such a uniform texture as the Pink Gum. Tests were made of this timber from trees fourteen and twenty-nine years old, and although the results were not so good as those from the mature tree they

showed that even at this age the timber is strong enough for all ordinary engineering purposes, although it probably will not have the same lasting properties. Manna Gum and White Gum *(E. rubida)* appear to be the poorest of our timbers.

I am indebted to Mr. Gill for so willingly supplying me with the necessary timber, and also for the interest he has taken in the work, which has been done at intervals as other work permitted. My thanks are also due to Mr. W. E. Gray for assistance with the experiments.

BEAM EXPERIMENTS (S.A. TIMBERS).

Timber.	No. of Tests.	Average Percentage of Moisture.	Modulus of Rupture.	Modulus of Elasticity.	Remarks.
			Lbs. per sq. inch.	Lbs. per sq. inch.	
Blue Gum ...	7	14	10,550	1,598,300	
Manna Gum ...	2	16	9,880	1,426,000	
Pink Gum ...	2	13	12,578	1,596,000	
Stringy Bark—					
(*a*) *E. obliqua*...	1	13	14,040	1,979,000	
(*b*) *E. capitulata*	2	11	14,343	1,915,500	
Red Gum ...	6	12	11,373	1,220,000	
Box Gum ...	4	16	13,900	2,058,000	
Sugar Gum ...	3	15	15,662	2,215,009	From matured tree, Wirrabara
,, ,, ...	1	15	9,717	1,544,000	From tree 29 years old, Bundaleer
,, ,, ...	2	12	15,575	2,234,000	From tree 14 years old, Malvern
Peppermint Gum	4	17	13,600	2,374,000	
Bastard Rox ...	5	11	12,240	1,637,000	
White Gum (*E. rubida*) ...	1	12	8,391	1,550,000	
Pinus insignus ...	1	11	3,504	1,059,000	Grown at Wirrabara
American Oak ...		12	11,500	1,800,000	

STRENGTH OF SOUTH AUSTRALIAN TIMBERS IN DIRECT TENSION.

Timber.	No. of Tests.	Average Percentage of Moisture.	Ultimate Strength in pounds per square inch.	Modulus of Elasticity.	Remarks.
				Lbs. per sq. inch.	
Blue Gum ...	4	13	10,675	2,519,000	
Manna Gum ...	1	52	6,400	695,000	
,, ,, ...	1	12	9,151	1,530,000	From Kuitpo
Pink Gum ...	1	26	10,430	1,900,000	,,
,, ,, ...	1	10	12,029	2,600,000	,,
Stringy Bark (*E. obliqua*) ...	2	11	14,100	2,784,000	,,
Red Gum ...	1	37	9,141	1,113,000	
,, ,, ...	3	10	7,005	1,299,000	
Box Gum ...	2	11	11,257	3,119,000	
Sugar Gum ...	2	10	7,204	1,314,000	From matured tree, Wirrabara
Peppermint Gum	2	13	8,079	2,636,500	
Bastard Box ...	2	10	8,660	2,227,000	
White Gum (*E. rubida*) ...	2	12	6,759	1,652,000	
American Oak ...		12	10,000		

SHEARING STRENGTH OF SOUTH AUSTRALIAN TIMBERS.

Timber.	No. of Tests.	Average Percentage of Moisture.	Shearing Strength per square inch.	Remarks.
Blue Gum ...	2	26	834	
,, ,, ...	4	10	1,162	
Manna Gum ...	2	25	808	
,, ,, ...	2	10	943	
Pink Gum ...	2	25	1,264	
,, ,, ...	2	10	1,539	
Stringy Bark (*E. obliqua*) ...	2	23	1,064	
,, ,, ...	2	11	1,448	
Red Gum ...	2	22	1,243	
,, ,, ...	2	10	1,554	
Box Gum ...	2	9	1,710	
Sugar Gum ...	4	9	1,762	From matured tree
,, ,, ...	2	11	1,661	From tree 29 years old
,, ,, ...	2	11	1,106	From tree 14 years old
Peppermint Gum	2	10	1,335	
Bastard Box ...	2	10	1,657	
White Gum (*E. rubida*) ...	2	22	488	
American Oak ...		12	1,000	

STRENGTH OF SOUTH AUSTRALIAN TIMBERS IN COMPRESSION ALONG THE GRAIN.

Timber.	No. of Tests.	Average Percentage of Moisture.	Ultimate Strength in Compression.	Remarks.
Blue Gum ...	5	16	6,853	
Manna Gum ...	2	17	5,378	
Pink Gum ...	3	13	8,600	
Stringy Bark—				
(*a*) *E. obliqua*...	2	13	7,967	
(*b*) *E. capitulata*	1	11	8,700	
Red Gum ...	5	12	6,202	
Box Gum ...	4	18	8,176	
Sugar Gum ...	5	16	8,400	From fully matured tree
,, ,, ...	4	15	6,953	From tree 29 years old
,, ,, ...	2	12	7,933	From tree 14 years old
Peppermint Gum	4	18	8,068	
Bastard Box ...	2	31	6,160	
White Gum (*E. rubida*) ...	2	12	6,399	
Pinus insignus ..	2	12	3,753	
American Oak ...		12	8,000	

STRENGTH OF SOUTH AUSTRALIAN TIMBERS IN COMPRESSION ACROSS THE GRAIN.

Timber.	No. of Tests.	Average Percentage of Moisture.	Load Required to produce 3% Deformation	Load Required to produce 15% Deformation.	Remarks.
			Lbs. per sq. inch.	Lbs. per sq. inch.	
Blue Gum ...	5	16	4,628	Over 6,025	One specimen beyond limits of machine
Pink Gum ...	2	12	4,899	Over 7,033	Beyond limits of machine
Red Gum ...	2	11	3,529	5,303	
Box Gum ...	5	17	4,243	5,681	
Sugar Gum ...	2	16	2,940	Over 6,630	Beyond machine limits (matured timber)
,, ,, ...	2	15	3,246	4,866	Tree 29 years old
,, ,, ...	2	12	2,717	3,862	Tree 14 years old
Peppermint Gum	2	18	3,196	6,446	
Bastard Box ...	1	30	3,085	5,185	
White Gum (*E. rubida*) ...	2	12	1,890	3,024	
Manna Gum ...	2	13	1,692		
Pinus insignus ...	2	11	896	1,164	
American Oak ...		12	1,980		

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part IX.

By Jos. C. Verco, M.D. (Lond.), F.R.C.S. (Eng.).

[Read October 6, 1908.]

Plates XIV. to XVIII.

Turbo jourdani, Kiener. Pl. xviii., f. 32, 33.

This very rare shell was named and described by Kiener in 1839 in the Rev. Zool. Soc. Cuvier, p. 324, and figured in the Mag. de Zool. de Guérin, 1840, Moll., pl. ix. To neither of these works have we access.

In 1843 Deshayes, in his edition of Lamarck's Anim. s. Vert., vol. ix., p. 224, says it belonged to the collection of Mons. Jourdan, after whom it was named.

In 1846 Philippi, in the Conch. Cab., ed. ii., Band ii., Abt. ii. and iii., p. 56, pl. xiii., f. 4, gives a description and figure, with the remark that he had never seen the species.

In 1848 Reeve, in Conch. Icon., Sp. 41, pl. xiii., writes: "Of this species there are two examples in the British Museum."

In 1873 Fischer, in Coq. Viv., Genus Turbo, p. 11, pl. xviii., gives a description and an excellent illustration of the smooth form.

In 1887 G. B. Sowerby, in the Thes. Conch., vol. v., p. 192, Sp. 8, pl. vi., f. 62, figures the form, which is validly spirally ribbed in the spire-whorls and obsoletely in the body-whorl.

The rarity of the shell is evident from the fact that all the above references but two are to the single shell belonging to M. Jourdan. Its habitat was the very indefinite one of "Australia" and "New Holland."

In 1888 Mr. M. M. Maughan found an immature example on the beach of Moonta Bay, in Spencer Gulf. It was identified by Prof. Tate, who held the opinion very strongly that it had been transported thither in ballast. Mr. Maughan saw no ballast about the beach, nor did he at any time gather any foreign shells there, although he did much collecting in the Bay. But no second specimen was ever taken.

In July, 1888, Mr. T. C. Watson, of Streaky Bay, South Australia, gave Mr. W. T. Bednall three specimens, the

largest and best of which, containing the operculum, he presented to the South Australian Museum. It is nearly full-grown, but has had all the coloured external layer removed by erosion except near the aperture, where the mahogany tint and darker lines are still preserved.

On August 1, 1893, the late Prof. Tate, at a meeting of the Royal Society of South Australia, exhibited a specimen obtained in a subfossilized state from the silt of the Port Adelaide Creek at a depth of 24 ft. (Trans. Roy. Soc., S. Austr., vol. xvii., p. 354). This proved the existence at no very remote period of time of this species on the shores of South Australia, and located it in our extra-tropical southern coastline rather than in the tropical waters of Australia.

In 1905 Mr. A. Zietz kindly presented me with an immature bleached individual, which he had received from Fowler Bay.

In December, 1907, Dr. Torr and I searched the West Coast of this State at Port Elliston, Venus Bay, Smoky Bay, Streaky Bay, Scales Bay, Murat Bay, and Denial Bay, and LeHunte Bay, without finding a fragment of this species. But on St. Francis, the largest island in Nuyts Archipelago, we discovered its habitat, and gathered a score of examples in a state of greater or less dilapidation. Although Peron and Baudin called here and carried home many shells from this island and St. Peter's, they seem to have overlooked this Turbo. St. Francis lies some thirty-two miles from Murat Bay, and seventeen miles from the nearest point on the mainland. It has a number of reefs running out into the sea in a southerly, south-westerly, and westerly direction, with small sandy intervening bays. The southern swell is constantly breaking on these rocks and rolling as a surf into the tiny bays. The Turbos were found wedged between the piled-up boulders on the leeside of the reefs and in the crevices of rocks, and their opercula were cast up on the sandy beaches. It is really an ocean island, and is surrounded by water of thirty fathoms in depth.

We sought for living individuals, but unsuccessfully. Mr. Arnold, who has lived there for many years, found only one, just below watermark, on a rock face on the north of the island, some years ago. He says the animal is of a red colour.

On the top of the rocks were large quantities of opercula and fragments of *Turbo stamineus*, Martyn, which had been taken by gulls from the reefs at low water, and smashed so as to permit them to eat the shellfish; but we did not find a single fragment or operculum of *T. jourdani* among these remnants. Again, although immature *T. stamineus* were

common among the abundant rock-shells cast up on the shore, we collected only two tiny *T. jourdani*. We concluded, therefore, that this rare species lives at a greater depth than *T. stamineus*, hence the gulls cannot get them, and they are but seldom washed up. Dr. Torr explored the reefs in water up to his breast, secured by a safety-line to prevent him from being carried away by the undertow of the swell; but though *T. stamineus* was obtained in abundance, not a single example of *T. jourdani* was taken. This deeper habitat probably accounts for its rarity in collections.

Since writing the above Mrs. J. F. Irvine, of Ingleside, Tasmania, tells me she has two fairly good specimens, sent to her some years ago by Captain Irvine. They came from Rottnest Island, off the western coast of Western Australia. Dr. Torr also informs me that an individual was taken alive by Mr. Kopp, when he was keeper of the lighthouse at Cape Borda, Kangaroo Island, at low tide, between Cape Borda and Snug Cove, on the shore of Investigator Strait.

The operculum was unknown to Kiener. It is of an oval shape, paucispiral, the largest having only five whorls, with the nucleus at a distance from the wider end of about one-fifth of the long diameter, proportionately much nearer the margin than in any other of our Turbos. The internal surface is slightly concave, with a low rounded cushion where the new spiral touches the old; beyond this is a shallow, rapidly-widening, slightly spiral depression, extending to the border. The external surface is smooth and polished. One margin, in an example 81 mm. in its long diameter, is 16 mm. in thickness, and the opposite is 5 mm., with a gradual slope between. A low spiral fulness runs obliquely across the outer face corresponding with the depression on the other side.

Turbo gruneri, Philippi. Pl. xviii., f. 36, 37.

Philippi, in Zeit. fur Malak, 1846, p. 98, gives the type locality as "The Colony of Adelaide, New Holland." It occurs all along our South Australian coastline, as would be expected since it is found in Victoria, and in Western Australia as far round as Swan River (Sowerby). It has been dredged alive in 12, 13, 15, and 16 fathoms in Investigator Strait and in the open sea outside Backstairs Passage.

The operculum is elliptical and thick, paucispiral, with a chitinous layer on its inner surface. The outer surface is smooth, but shows some curved earlike processes, similar to but not nearly so valid as those found on the opercula of *T. stamineus*.

This character would place it between the *T. undulatus*, Martyn, which is smooth on the outside, and *T. stamineus*, which is markedly auriform and prickly. (Pl. xviii., f. 38, 39, and 34, 35.)

Gibbula legrandi, Petterd.

Fossarina legrandi, Petterd, Journ. of Conch., 1879, p. 104. *Gibbula legrandi*, Petterd, Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 404, pl. xxiv., f. 21, 22; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1902, vol. xv., part 2, p. 133.

Beachport, shell sand (Verco).

Gibbula galbina, Hedley and May.

Gibbula galbina, Hedley and May, Records of the Austr. Mus., vol. vii., No. 2, 1908, p. 114, pl. xxii., f. 2. *Type locality.* —100 fathoms, off Cape Pillar, Tasmania.

Taken in 110 fathoms off Beachport, two examples dead, one specimen in 130 fathoms off Cape Jaffa.

Minos petterdi, Crosse.

Fossarina petterdi, Crosse, Journ. de Conch., 1870, p. 303; 1871, p. 323, pl. xii., f. 1; Tryon, Man. Conch., 1887, vol. ix., p. 275, pl. lii., f. 20, 21; Pritchard and Gatliff, Roy. Soc., Vict., 1902, vol. xiv. (N.S.), part 2, p. 94.

Minos petterdi, Crosse; Hutton, Proc. Linn. Soc., New South Wales, 1884, p. 369; Lodder, Proc. Roy. Soc., Tasm., 1900, Cat. Tasm. Shells (p. 12 of reprint); Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 403.

Fossarina simsoni, Tenison-Woods, Proc. Roy. Soc., Tasm., 1876, pp. 149, 150; Tenison-Woods, Proc. Roy. Soc., Vict., 1881, vol. xvii., p. 81; Tryon, Man. Conch., 1887, vol. ix., p. 275.

Glenelg Beach (W. L. Bragg); Henley Beach; St. Francis Island (Verco).

Rissoina rhyllensis, Gatliff and Gabriel.

Rissoina rhyllensis, Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), p. 367, pl. xxi., f. 8. *Type locality.* —Western Port, Victoria.

Dredged in Gulf St. Vincent, several; in 25 fathoms Thorny Passage, one alive, and one dead: one dead in 49 fathoms off Beachport, in 55 fathoms off Cape Borda, and in 90 fathoms off Cape Jaffa; in 110 fathoms off Beachport, forty, some quite fresh; in 130 fathoms off Cape Jaffa, seventeen good and poor; and in 150 fathoms off Beachport, thirteen, fairly good. It seems, therefore, to live in about 100 fathoms, and to be less frequent in the shallower and deeper water.

Rissoina lintea, Hedley and May.

Rissoina lintea, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 117, pl. xxiii., f. 11. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged at the same stations as the preceding species, but in smaller numbers.

Turritella kimberi, n. sp. Pl. xv., f. 14, 15.

Shell thin, long, narrow, imperforate, of ten whorls without the protoconch, which is absent. Another individual shows a long tapering protoconch of four smooth convex white whorls. Sutures deep. Spire-whorls well rounded; with equidistant, low, spiral ribs, six in the penultimate, the infrasutural one being the least valid, the upper slope of the rib very steep and short, nearly vertical, the lower long and sloping; the intercostal furrows appearing in the throat as opaque white capillary spiral lines. The body-whorl has ten spirals; base convex. Aperture slightly oblique, elliptical; outer lip thin, uniformly convex; inner lip a scarcely perceptible glaze on the body-whorl; columellar lip nearly straight, narrowly reflected; basal lip slightly effuse. Colour translucent white.

Dim.—Length, 7·7 mm.; breadth, 1·7; length of aperture, 1·4 mm.; width, ·9.

Locality.—Type, Backstairs Passage, 20 fathoms, with eight others fresh but dead. Port Willunga, one (Kimber).

Type in Dr. Verco's collection.

Obs.—It may reach 8·5 mm. in length.

Diagnosis.—Turitella parva, Angas, differs in its brown colour and its light chestnut sutural band, its three keels on the whorls, its subquadrate aperture, and in its columella thickened and produced at the base.

Seila attenuata, Hedley, superficially resembles it, but differs in its anterior notch.

Seila attenuata, Hedley.

Seila attenuata, Hedley, Proc. Linn. Soc., New South Wales, 1900, vol. xxv., part 1, p. 91, pl. iii., f. 9, 9*a*. *Type locality.*—Middle Harbour, Sydney. Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1906, vol. xviii. (N.S.), part 2, p. 60., Ocean Beach, Point Nepean.

Newland Head, 20 fathoms, one dead; Backstairs Passage and Gulf St. Vincent, eighteen.

Ovula formosa, Adams and Reeve.

Ovula formosa, Adams and Reeve, Voy. Samarang, p. 22, pl. vi., f. 6; Tryon, Man. Conch., vol. vii., 1885, p. 251, pl. iv., f. 15, 16, "Borneo, Japan."

Dredged one example, during many years' dredging in waters from Beachport to the Neptunes, including Gulf St.

Vincent and Spencer Gulf. This was identified for me by Mr. Hedley, who suggested that as a tropical form it had migrated round the western coast of Australia to South Australia, not being found on the eastern coast. This was supported by the securing of a second specimen in better condition, in 30 fathoms, off St. Francis Island, in the Great Australian Bight, during one day's dredging.

Septa petulans, Hedley and May.

Septa petulans, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 118, pl. xxiii., f. 14. *Type locality.*—Pirate's Bay beach, near Cape Pillar, Tasmania; also 100 fathoms off Cape Pillar.

I found a specimen some years ago on the beach at Eagle Hawke Neck, Tasmania, which is identical with the type (*teste* Hedley). Also dredged broken in 200 fathoms off Beachport.

Cymatium columnarium, Hedley and May.

Cymatium columnarium, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 119, pl. xxiii., f. 15. *Type locality.*—100 fathoms off Cape Pillar, Tasmania.

Dredged in 40 fathoms off Beachport, one good; in 60 fathoms north-west of Cape Borda, one immature; in 100 fathoms off Beachport, one good (identified by C. Hedley from the type); in 110 fathoms off Beachport, one good; in 130 fathoms off Cape Jaffa, one good, immature; in 150 fathoms off Beachport, one poor, and in 200 fathoms off Beachport, two poor.

Pyrene plexa, Hedley.

Columbella plexa, Hedley, Proc. Linn. Soc., New South Wales, 1901, part 4, p. 702, f. 25. *Type locality.*—Port Jackson: Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 112, 100 fathoms off Cape Pillar, Tasmania.

Dredged in 104 fathoms, 35 miles south-west of Neptune Islands, fourteen examples.

Arcularia mobilis, Hedley and May.

Arcularia mobilis, Hedley and May, Records Austr. Mus., vol. vii., No. 2, p. 121, pl. xxiii., f. 16, with var. *costata*, f. 17. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in 100 fathoms off Beachport, one immature; in 130 fathoms off Cape Jaffa, twelve, some good, mostly poor; in 150 fathoms off Beachport, two nearly mature; in 200 fathoms off Beachport, one immature. No examples were taken alive. They do not quite conform either to the type or the variety. As regards the axial costæ they are intermediate, and the spirals are sharper, and wider apart than in either form.

One shell, taken in 150 fathoms off Beachport, is much more attenuate than the type. This measures 7 mm. by 4 mm., whereas that is 6 mm. by 2·9 mm.

Arcularia grandior, n. sp.

Plate xv., f. 16, 17.

Shell large and solid. Whorls nine. Protoconch $2\frac{1}{4}$ turns, smooth; apex scarcely exsert; first whorl depressedly convex, second vertically flatly convex. Spire-whorls convex, shouldered; the angulation starting in the first whorl close to the suture, proportionately more distant from it and less acute in each succeeding whorl, in the penultimate just above the middle. Suture distinct, undulating, narrowly margined. Body-whorl scarcely shouldered. Aperture axially obliquely ovate; outer lip simple, thin, in profile slightly centrally concave; columella concave, obtusely angled at the commencement of the canal which deviates well to the left and is recurved; inner lip, a smooth glaze, complete; notch marked. Sculpture bold; axial costæ, 16 in the penultimate, extending from suture to suture, acute, concavely rounded, as wide as the interspaces, and narrowing over the base to the notch; spirals valid, sharp, concavely rounded, as wide as the spaces, crossing and transversely tuberculating the axials, three in the first whorl, six principals in the penultimate with three intercalated secondaries, 20 altogether in the body-whorl extending validly to the notch; irregular crowded interstitial accremental striæ.

Dim.—Length, 32·5 mm.; of body-whorl, 13 mm.; width, 15 mm.

Locality.—Dead in blue clay in 110 fathoms off Beachport, 3 large; 100 fathoms, 3 fragments; 150 fathoms, 3 fresh, juvenile; 200 fathoms, 2 fresh, juvenile; off Cape Jaffa, in 300 fathoms, 2, juvenile; off Cape Borda, in 55 fathoms, 1 embryonic.

Type in Dr. Verco's collection.

Obs.—A second individual, figured (pl. xv., f. 17); is rather less elate, and the angled shoulder is more persistent. The type is stained blue, but another example is of a light-yellowish-brown tint.

Coralliophila elaborata, H. and A. Adams.

Coralliophila elaborata, H. and A. Adams, Proc. Zool. Soc., Lond., p. 433. *Type locality.*—"Sandwich Islands." Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), part 1, p. 369, "San Remo and Lorne."

Taken at St. Francis Island, west coast of South Australia, alive in a rock pool, and dead in numbers. Some

specimens are quite white, but others are of a deep bluish-purple in the aperture and on the columella, and the colour is faintly visible through the shell. The largest example is 26 mm. long, and 16 mm. in its greatest diameter.

This species was kindly identified by Mr. Gatliff, from Victorian specimens, compared with the British Museum type by Mr. Gabriel, with Mr. E. A. Smith's help.

Coralliophila rubrococcinea, Melvill and Standen.

Coralliophila rubrococcinea, Melvill and Standen, Proc. Zool. Soc., Lond., 1901, p. 401, pl. 21, f. 2. *Type locality.*—"Persian Gulf." Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), part 1, p. 368, "Port Fairy and San Remo, Victoria."

Port MacDonnell Beach.

Identified by Mr. Gatliff, as in the previous species.

Trophon columnarius, Hedley and May.

Trophon columnarius, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 121, pl. xxiv., f. 22. *Type locality.*—100 fathoms off Cape Pillar, Tasmania.

Dredged in 40 fathoms off Beachport, three good (one identified by C. Hedley, from type in Austr. Mus.).

Trophon molorthus, Hedley and May.

Trophon molorthus, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 122, pl. xxiv., f. 23. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in 150 fathoms off Beachport, five; in 200 fathoms, five; also, in 130 fathoms off Cape Jaffa, three: all dead shells; identified by C. Hedley, from type in Austr. Mus., Sydney.

Marginella columnaria, Hedley and May.

Marginella columnaria, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 120, pl. xxiii., f. 19. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in Gulf St. Vincent at depths below 25 fathoms, one alive, six good, ten poor; in Backstairs Passage, 22 fathoms, five alive, and in 12, 15, 17, and 20 fathoms, eight dead; in 40 fathoms off Beachport, three good, three poor; in 45 fathoms east of Neptune Islands, one good, immature; in 55 fathoms north-west of Cape Borda, two good and four immature; and in 90 fathoms off Cape Jaffa, one very poor. This species seems, therefore, to live chiefly at about 20 fathoms, and beyond 60 fathoms to be found only in poor condition.

Limæa parvula, sp. nov. Pl. xv., f. 10 to 13.

Shell small, thin, white: obliquely oval. Umbos central, inflated, projecting approximate. Hinge-margin straight;

dorsal area transversely elongate, narrowly triangular. Anterior dorso-lateral angle obtuse, about 135 deg.; posterior about 100 deg. Anterior border slightly concave for about one-fourth of its length, then uniformly slightly convex. Posterior border much shorter, at first sub-concave, then nearly straight. Ventral border semicircular, joining the anterior border with a more open sweep than the posterior. Surface convex; with sixteen radial ribs, smooth, rounded, nearly as wide as the interspaces, with several intercalated riblets. Concentric striæ granulate the intercostal spaces, and form sublenticular costulæ on the sides, more marked on the anterior, near the dorsal border.

The cartilage-pit is sub-central, and triangular crossing the dorsal area to the umbo, concave. Hinge-plate narrow near the pit, widest at the angles; teeth about seven on each side, diverging, extending slightly along the lateral borders.

Interior slightly furrowed by the ribs. Ventral border squarely denticulated.

Dim.—Umbo-ventral diameter, 3·5 mm.; 3·7 mm., including the umbo; antero-posterior, 3 mm.

Hab.—Type locality. 104 fathoms, 35 miles south-west of Neptune Islands, 40 valves; 90 fathoms off Cape Jaffa, 1 valve.

Type in Dr. Verco's collection.

Mytilicardia crassicosta, Lamarck.

Cardita crassicosta, Lamarck, Anim. S. Vert., 1819, vol. vi., pt. 1, p. 24, No. 13.

Cardita citrina, Lamarck, *op. cit.*, p. 637, No. 21.

Cardita crassicostata, Reeve; Conch. Icon., 1843, vol. i., pl. 2, f. 7, *a, b, c, d, e.*

Cardita tridacnoides, Menke; Moll. Nov. Holl., 1843, p. 39, No. 222.

Dredged alive at all depths from 8 fathoms to 24, in both Gulfs and Straits. Very young individuals have been taken alive in 45 fathoms off Beachport and east of the Neptunes, and in 55 fathoms off Cape Borda. Small valves occur in numbers in 100 and 110 fathoms off Beachport, and in 130 fathoms off Cape Jaffa. It would appear as if very few mature shells are found above 15 fathoms, though the range of the smaller individuals extends to over 50 fathoms.

Some small specimens are of a uniform rosy-pink colour; others have the dorsal two-thirds of the posterior half of a very dark-brown internally. The ventral border may be quite straight, or very deeply excavate in front of its centre. There may be a sort of dorsal fin just in front of the posterior-dorsal angle, due to expansion of a radial rib. The shell may be elongate transversely and low umbo-ventrally, or short

and very high. The ribs may be acute and scaly, or may become nearly obsolete, especially behind the umbo-ventral ridge.

It may attain a transverse length of 65 mm., 10 mm. more than that of Lamarck's type. This may vary considerably in proportion to the umbo-ventral height, as may also the prominence of the curved costal scales.

Mytilicardia calyculata, Linnæus.

Chama calyculata, Linnæus; Syst. Nat., 1767, p. 1138.

Cardita calyculata, Lamarck; Anim. S. Vert., 1819, vol, vi., part 1, p. 24.

Cardita aviculina, Lamarck; *op. cit.*, p. 26, No. 20.

Cardita excavata, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 100, pl. xvii., f. 1-3.

Mytilicardia tasmanica, Tenison-Woods; Proc. Roy. Soc., Tasm., 1876, p. 161.

Taken on the beach at Venus Bay, West Coast of South Australia; very rarely dredged.

Mytilicardia concamerata, Chemnitz.

Cardita concamerata, Reeve, Mon., t. 9, f. 42.

Thecalia macrotheca, A. Adams and Angas, Proc. Zool. Soc., Lond., 1864, p. 39.

Mytilicardia concamerata, Chemnitz, Tate, Trans. Roy. Soc., S. Austr., vol. ix., 1886, p. 100.

The habitat is given as "under stones at low tide," "Rapid Bay, South Australia" (Coll. Angas). But there were no specimens in Tate's collection. I have not taken it anywhere, nor has any collector other than Angas recognized it. It does not appear to have been recorded from Victoria, Tasmania, or Western Australia. Possibly some shells from elsewhere were by mistake placed among those in Angas's collection from South Australia.

Venericardia dilecta, E. A. Smith.

Pl. xiv., f. 8.

Cardita dilecta, E. A. Smith; Challenger Rep., Zool., 1885, vol. xiii., p. 213, pl. xv., f. 4, 4*a*. *Dim.*—Length 8 mm., height 6 mm., diameter 5·5. *Hab.*—"Off East Moncœur Island, Bass Strait," in 38 to 40 fathoms.

This has been dredged in Backstairs Passage in 17 fathoms, two alive and many valves; in 22 fathoms, two alive and forty-eight valves; and in Gulf St. Vincent, depth unnoted, many alive and dead; in 25 fathoms off Beachport, two poor valves; in 45 fathoms east of the Neptune Islands, one alive and eighteen valves; in 55 fathoms off Cape Borda, two poor valves; in 100 fathoms off Beachport, eight valves in poor and nine in moderate condition; in 130 fathoms off Cape

Jaffa, one whole shell and one valve, both in poor condition. This species would seem to live in water up to 45 fathoms, but not beyond. Its limit in shallow water below 17 fathoms is unknown.

My examples are 8·2 mm. by 6·7, and 8·1 by 6·9 mm., and are, therefore, proportionately somewhat higher than the type, but otherwise correspond. One is 9·25 mm. by 7·5, a large specimen.

Venericardia dilecta, E. A. Smith. Var. **excelsior**, var. nov.

Pl. xiv., f. 9.

It closely resembles *C. dilecta*, Smith; but is rather more ventricose, is less equilateral, the umbo being more anterior, the post-dorsal border is longer and less sloping, the umbo-ventral depth is greater, the ribs are not quite so valid, the ventral margin is more curved, it has not the pink tinge about it, it is blotched and articulated with a darker brown.

Dim.—Length, 7·8 mm.; height, 7·3 mm.

Hab.—55 fathoms off Cape Borda, one valve; 100 fathoms off Beachport, six alive, and more than 750 valves quite fresh; 130 fathoms off Cape Jaffa, four alive, thirty-three valves quite fresh; 150 fathoms off Beachport, one alive, 750 valves; 200 fathoms off Beachport, forty-nine valves, and one alive. The proper habitat of this shell is evidently from 100 to 150 fathoms, only one valve having been found at a less depth. This circumstance, with the hiatus of about 50 fathoms between it and *V. dilecta*, almost suggests its right to be considered a separate species.

It is much more orbicular than my specimens of *V. dilecta*, and still more so than the type. Curiously enough Mr. Smith's artist has drawn a figure which, instead of corresponding with the dimensions in his text, measures exactly 26·5 mm. both in height and length, so as to represent an orbicular shell, instead of 26·5 in length and 19·9 in height, which are the proportions of his described type.

Some of my specimens are quite white, and some have concentric bands of a less opaque white in them.

Type in Dr. Verco's collection.

Venericardia amabilis, Deshayes.

Cardita amabilis, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 102, pl. xvii., f. 8, 9. *Hab.*—"New Zealand"; Tate and May, Proc. Linn. Soc., New South Wales, 1901, part 3, p. 434, "South coast of Tasmania"; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xviii. (N.S.), part 1, p. 232, "Western Port, Victoria."

Dredged alive in Spencer Gulf in 17 fathoms and 20 fathoms, about two-thirds full-grown size; in 25 fathoms off Beachport, one small individual alive, also two valves full

grown; in 40 fathoms off Beachport, one alive, immature, and 152 valves, the largest being 22 mm. antero-posteriorly and 19·5 mm. umbo-ventrally; in 45 fathoms east of Neptunes, four valves; in 49 fathoms off Beachport, nine valves, half grown; in 62 fathoms north-west of Cape Borda, two valves; in 90 fathoms off Cape Jaffa, five alive up to 10 mm. in length, and 104 valves up to 12 mm.; in 100 fathoms off Beachport, one alive, immature, and 140 valves up to 13 mm. in length; in 130 fathoms off Cape Jaffa, very many valves; in 150 fathoms off Beachport, 107 valves; in 200 fathoms off Beachport, fifty-two valves up to 10 mm. in length. Its range in depth is considerable, up to 100 fathoms in life, and up to 200 fathoms as valves in quantity.

The smaller individuals appear to be comparatively longer; thus the measurements are 9·75 antero-posteriorly, 8·25 umbo-ventrally, 5·50 sectionally; then 12·5, 11·25, 8·25, and 17·5, 17·5.

This shell has been previously recorded for South Australia by Prof. Tate in Trans. Roy. Soc. S. Austr., 1888, vol. xi., p. 68, as *C. beddomei*, E. A. Smith, Chall. Rep. Zool., 1885, vol. xiii., p. 211, pl. xv., f. 5. But our shell is identical with shells from Tasmania and Victoria sent as *C. amabilis*, Desh., and I cannot recognize any specific distinction between our species and the description and figure of Deshayes, or between those of Deshayes and Smith. I think *V. beddomei* will prove to be a synonym of *V. amabilis*.

Cardita gemmulifera, Tate, Trans. Roy. Soc. S. Austr., 1892, vol. xv., p. 130, pl. i., fig. 9, is only a mild variant of the above, and cannot be granted specific position.

Venericardia quoyi, Deshayes.

Cardita quoyi, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 103, no plate: *Hab.*—"New Holland"; Tate and May, Proc. Linn. Soc., New South Wales, 1901, part 3, p. 434, "Badger Island," Tasmania; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xviii. (N.S.), part 1, p. 232, "Flinders, Western Port," Victoria.

Cardita rosulenta, Tate; Trans. Roy. Soc., S. Austr., 1887, vol. ix., p. 69, pl. v., f. 3, "Encounter Bay and Backstairs Passage."

Dredged alive in Eastern Cove, Kangaroo Island, one specimen in 11, in 14, and in 19 fathoms; also in Backstairs Passage, two in 13 fathoms, two in 16 to 18 fathoms, three in 20 fathoms, and one in 22 fathoms. Valves only were taken in good condition in 25 fathoms off Beachport, two, and in 40 fathoms, twenty-four valves; in 55 and 60 fathoms off Cape Borda, eighteen; in 110 fathoms off Beachport, six; in fair condition in 130 fathoms off Cape Jaffa, six; in 150 fathoms off Beachport, one; and in 200 fathoms, two.

Venericardia squamigera, Deshayes.

Cardita squamigera, Deshayes; Mag. Zool., 1853, p. 10; Reeve, Conch. Icon., pl. iv., f. 14: *Hab.*—"Unknown"; Tate, Trans. Roy. Soc., S. Austr., 1888, vol. xi., p. 68, "Spencer Gulf, off Kangaroo Island."

Dredged alive in Gulf St. Vincent, Spencer Gulf, and in Backstairs Passage; four in 10 fathoms, five in 12, one in 15, two in 17, seven in 20, five in 22 fathoms. Valves were taken, but only of small size, as follows:—Seventeen in 55 fathoms and one in 62 fathoms off Cape Borda; one in 110 fathoms off Beachport; and two in 300 fathoms off Cape Jaffa. I have not collected it on any of our beaches.

It attains a length of 25 mm., with a height of 19 mm., nearly three times the dimensions given by Tate, *viz.*, three-eighths of an inch by a quarter of an inch, or 9 mm. by 6.

Venericardia bimaculata, Deshayes.

Cardita bimaculata, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 101, pl. xvii., f. 4, 5: *Hab.*—"New Zealand, Coll. Cuming;" Tate, Trans. Roy. Soc., S. Austr., 1892, vol. xv., p. 134, records it for South Australia, and says "it is not admitted by Prof. Hutton in his revised list of New Zealand Mollusca" as living in New Zealand; Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 434, for Tasmania: Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xviii. (N.S.), part 1, p. 232, "Port Phillip and Western Port."

Cardita gunni, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 101, *Hab.*—"Van Diemen's Land" (Coll. Cuming).

Cardita atkinsoni, Tenison-Woods; Proc. Roy. Soc., Tasm., 1876, p. 27, *Hab.*—"Long Bay, Tasmania."

This species varies greatly in shape; one may be 15·25 mm. antero-posteriorly, 12 mm. umbo-ventrally, and 7·75 in section, and another 13·75, 12·25, and 9·75 in its respective measurements. The difference is not due to age, for each form can be traced from minute to full size. But intermediate grades occur. The ribs may vary from 15 to 23.

Dredged alive in Gulf St. Vincent, Spencer Gulf, Investigator Strait, and Backstairs Passage. Seven in 5 fathoms, sixty-two in 5 to 10 fathoms, twenty-seven in 10 to 15 fathoms, 134 in 15 to 20 fathoms, and sixty-four in 22 to 23 fathoms, one in 45 fathoms, off the Neptunes. Fifteen to 20 fathoms seems to be, therefore, its proper station, though one was taken alive in 40 fathoms off Beachport. Valves only were taken, sixty-five in 40 fathoms, eighteen in 55 fathoms, twelve in 60 fathoms, thirty in 100 fathoms, thirty-one in 130 fathoms, three in 150 fathoms, ten in 200 fathoms, and five in 300 fathoms.

Venericardia lutea, Hutton.

Cardita lutea, Hutton; Man. New Zealand Moll., 1880, p. 159: *Venericardia lutea*, Hutton, Hedley, Trans. New Zealand Inst., vol. xxxviii., 1905, p. 72, pl. i, f. 6.

Dredged 14 fathoms off Ardrossan, sixteen alive and several valves; 15 fathoms off Wallaroo, four alive and seven valves; 20 fathoms Gulf St. Vincent, two alive.

Venericardia columnaria, Hedley and May.

Venericardia columnaria, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 125, pl. xxv., f. 37-40. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

The South Australian shells are not quite so produced anteriorly as the type, and may have twenty-six ribs. They may reach 8·8 mm. in length and 7·7 mm. in height. Younger shells are comparatively more transverse. The colour is white, tinged with brown on the margins beyond the hinge plate; there may be brownish smears at both ends internally, or the pallial line and the muscle scars may be painted brown; or the outer surface may be faintly brown, most marked at the umbos.

Dredged in 40 fathoms off Beachport, five valves; in 49 fathoms, twelve valves; in 100 and 110 fathoms, very many valves; in 150 fathoms, seventy-six valves; and in 200 fathoms, seventeen valves; in 130 fathoms off Cape Jaffa, very many valves and one perfect shell. Its habitat is apparently from 100 to 150 fathoms.

Venericardia delicata, n. sp. Pl. xvi., f. 18, 19.

Shell rather thin, transversely oval, subequilateral. Umbos in front of centre, directed forward, rather prominent, approximate. Post-dorsal border sloping, barely concave, anterior concave. Front margin well curved, ventral less, posterior wider, somewhat truncately convex. Radial ribs twenty-four, narrower than their interspaces, high, closely and finely transversely scaled, denticulating the margins. Very fine accremental striæ crowd the intercostal spaces, a larger one corresponding with each scale. Lunule narrowly cordiform, smooth, prominent in the centre. Left valve with two diverging cardinal teeth, tiny anterior lateral tooth in front of lunule; right valve with wide triangular cardinal, socket in front of lunule, minute posterior lateral. Interior white glistening, rayed by ribs, margins denticulated.

Dim.—Antero-posterior diameter, 8·5 mm.; umbo-ventral, 7·2 mm.

Colour—Sparsely irregularly dotted outside with brown.

A living example is of a light greyish tint, spotted with brown disposed somewhat concentrically, and has the lunule

chestnut brown; and is 6·3 mm. long, 5 mm. high, and 3·8 mm. in section.

Hab.—Type, 130 fathoms off Cape Jaffa, with several valves; 90 fathoms, two alive and eighty-four valves; 300 fathoms, many valves; 110 fathoms off Beachport, six valves; 150 fathoms, twenty-four valves; 200 fathoms, twenty-three valves; 104 fathoms, thirty-five miles south-west of Neptune Islands, one alive, and many fresh valves.

Diagnosis.—It is most like *Venericardia bimaculata*, Deshayes; but is a more delicate shell, has more and narrower ribs, which are much more closely and finely scaled. The same features distinguish it from *V. quoyi*, Desh., and *V. difficilis*, Desh.

Type in Dr. Verco's collection.

Carditella exulata, E. A. Smith.

Carditella exulata, E. A. Smith; Challenger Rep., Zool., 1885, vol. xiii., p. 215, pl. xv., f. 6, 6*a*. *Type locality.*—"Off Nightingale Island, Tristan d' Acunha, 100 to 150 fathoms." *Dim.*—Length 4 mm., height 2·75, width 2 mm.

Our shells were taken in 130 fathoms off Cape Jaffa, four valves; 110 fathoms off Beachport, six valves; the beach at MacDonnell Bay in shell sand, many valves and one living individual; and at Kingston, Lacepede Bay, shell sand, many valves. I cannot detect any specific difference between these examples and Mr. Smith's, from his description and figure, except that ours are smaller, measuring 2·8 mm. by 1·8 mm. Some valves have the posterior part internally and the region of the lateral teeth stained brown. Tristan d'Acunha lies in about 12 deg. west longitude, and 37½ deg. south latitude, in the middle of the Atlantic Ocean. Beachport is in about 139½ deg. east longitude, and 37½ deg. south latitude. The latitude in which the type shells and ours were taken is, therefore, exactly the same; as is also the depth, 100 to 150 in the one case, and 110 in the other. These two circumstances might to some extent explain their identity. It will be noted, however, that most of our specimens were taken on the beach, where also the only living individual was secured. If the identification is correct, the distance between the two stations of 162 parallels of longitude, which at that latitude may be computed as about 9,000 miles, is very interesting.

Carditella subtrigona, Tate.

Carditella subtrigona, Tate, Trans. Roy. Soc., S. Austr., vol. ix., p. 70, pl. iv., f. 10. *Type locality.*—Streaky Bay, Great Australian Bight; Tate, *op. cit.*, vol. xiv., p. 268.

Dredged alive at all depths from 17 to 24 fathoms in Gulf St. Vincent, Investigator Strait, and Backstairs Passage, as far out as Newland Head.

It may reach 10 mm. in length and 10 mm. in height. When young the shell is comparatively longer antero-posteriorly than when adult, the umbos seem to project more dorsally, and the sectional diameter is less, so that the juvenile form might be mistaken for another species. To the characters given by Tate may be added that the shell may be white with dark-brown muscle scars and hinge-plate and pallial line, and in addition some have all the inner ventral part from above the pallial line to the margin a deep purple-brown. Rarely the whole shell has a light purple tint.

Carditella elegantula, Tate and May.

Carditella elegantula, Tate and May, Proc. Linn. Soc., New South Wales, vol. xxvi., 1901, part 3, p. 434. *Type locality.*—Blackman's Bay, Tasmania.

Dredged alive in Backstairs Passage in 22 fathoms and in 18 fathoms; also in Investigator Strait, 22 fathoms; dead in Spencer Gulf; Port Willunga (Mr. Kimber).

Carditella valida, n. sp. Pl. xvi., f. 22 to 24.

Shell solid, obliquely transversely oval, somewhat produced anteriorly. Umbos prominent, curved forward, acute, approximate, with a minute prodissoconch cap. Post-dorsal border markedly convex; anterior concave; ventral convex, more curved in front than behind, crenulate. About nineteen valid axial ribs, rounded, interspaces very narrow. Valid close-set concentric round cords cross the costæ, scarcely visible in the interspaces. The right valve has a wide triangular cardinal tooth, an anterior lateral separated by a groove from the margin, and a posterior marginal lateral. The left valve has two diverging cardinals, of which the posterior is the larger, a posterior lateral separated by a groove from the margin and an anterior marginal lateral. The internal ventral border is well denticulated. Lunule cordiform, depressed, smooth. Escutcheon long, lanceolate. Ligament visible externally. Colour brownish, especially over the posterior third. Internally brown in the posterior part fading anteriorly, lateral teeth brown, and inside the ventral margin. It may be wholly white, or of a very light purple tint.

Dim.—Antero-posterior diameter, 3·7 mm.; umbo-ventral, 3·6 mm.

Hab.—Encounter Bay (Tate); Gulf St. Vincent, under 22 fathoms, several alive and many valves. Taken in small numbers and poor condition in 25, 40, 62, 110, and 130 fathoms, from Beachport west to the Neptune Islands.

Diagnosis.—It was recorded by Tate for South Australia as *C. infans*, E. A. Smith, in Trans. Roy. Soc., S. Austr.,

vol. ix., 1886, p. 100, and listed by Adcock in his Handlist, 1893, No. 146. Mr. Hedley has sent me Smith's species, obtained from the type locality, and it appears to have less curved dorsal borders and fewer ribs, which are scaled, and not corded.

It very closely resembles *C. elegantula*, Tate and May, of which it may prove to be only a variety, in which case its name will indicate the difference, for it has fewer and higher ribs, with bolder and less crowded concentric cords, and is somewhat less oblique.

Type in Dr. Verco's collection.

Carditella vincentensis, n. sp. Pl. xvi., f. 20, 21.

Shell solid, roundly trigonal. Umbos projecting, approximate, curved forward. Dorsal borders converge at about a right angle; posterior straightly convex, anterior slightly excavate. Lunule elongate-cordate, depressed, smooth, its centre prominent, and seen as a convexity in the profile of the shell. Escutcheon well marked, elongate, bevelled edges, left valve overlapping the right. Twenty-two flattened rounded ribs, the posterior straight, the anterior concave forwards, interstices linear. Well-marked concentric liræ cross the ribs and spaces. Right valve has a central triangular cardinal tooth, a long anterior lateral tooth separated from the margin by a groove, and a thin posterior marginal lateral. The left valve has two diverging cardinal teeth, a posterior lateral separated from the margin by a groove, and an anterior marginal lateral tooth. The lateral teeth and sockets are microscopically vertically striate. Ventral border well denticulated internally. Colour white, reddish-brown tint on the posterior third of the shell, deepest at the posterior inferior angle.

Dim.—Antero-posterior diameter, 3 mm.; umbo-ventral, 2·85 mm.

Hab.—Gulf St. Vincent, Spencer Gulf, and Backstairs Passage, 20 and 22 fathoms, several alive and many valves.

Variations.—The posterior dorsal border may be quite straight. The colour may be wholly white, the brown tint may be continued across the middle to the front border, or it may be disposed in radially elongate spots on the ribs.

Diagnosis.—From *C. elegantula* by its straighter posterior border, by the prominence of the centre of its lunule, by being more equilateral, and by its colour.

Type in Dr. Verco's collection.

Cuna atkinsoni, Tenison-Woods, sp.

Kellia atkinsoni, Tenison-Woods, Proc. Roy. Soc., Tasm., 1877 (1876), p. 158. *Type locality.*—Long Bay, Tasmania.

Carditella atkinsoni, Tenison-Woods, Tate and May, Proc. Linn. Soc., New South Wales, vol. xxvi., 1901, part 3, p. 435, pl. xxvii., f. 107.

Cuna atkinsoni, Tenison-Woods, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 113, 100 fathoms off Cape Pillar, Tasm.

Dredged Gulf St. Vincent, under 22 fathoms, many whole and valves; 110 fathoms off Beachport, one valve; 130 fathoms off Cape Jaffa, five good valves.

Some examples have very fine concentric striæ and fewer marginal denticulations; others seem very solid, probably from senility; and one variety is much narrower and more solid, and has a broad solid hinge-plate; but the examples were too few to create a new species from them.

Cuna hamata, Hedley and May.

Cuna hamata, Hedley and May. Records Austr. Mus., vol. vii., No. 2, 1908, p. 124, pl. xxv., f. 33-36. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged off Beachport in 40 fathoms, one alive, eighty-six good valves; 49 fathoms, ten poor valves; 100 fathoms, fifteen good valves; 150 fathoms, sixty-five good valves; north-west of Cape Borda, 62 fathoms, ten poor valves; off Cape Jaffa, 130 fathoms, thirty-nine good valves. It has evidently a wide range in depth, though .none were taken in 200 or 300 fathoms.

During life it is of a translucent horn colour, opaque white when dead.

Cuna obliquissima, Tate, sp.

Cardita obliquissima, Tate, Trans. Roy. Soc., S. Austr., vol. ix., 1887, p. 70, pl. v., f. 9. *Type locality.*—22 fathoms, Encounter Bay.

Dredged at different depths in Gulf St. Vincent and Backstairs Passage; seven miles south-west of Newland Head in 20 fathoms, one alive, of faint pink tint; off Beachport in 40 fathoms, twelve good valves; in 49 fathoms, seventeen poor valves; off Cape Borda in 55 fathoms, one whole and twenty-five good valves; in 62 fathoms, four whole and three valves, all poor; off Beachport in 110 fathoms, nine valves, in moderate condition; in 150 fathoms, two valves, moderate. This lives chiefly in water up to 25 fathoms, and is in poor state above 60 fathoms, and not found above 150.

In addition to the stout "four or five radial riblets" on the posterior slope noted by Tate, living shells show fine axial riblets over the whole surface, quite to the anterior margin. The "distant concentric grooves" do not correspond in direction with the fine microscopic accremental striæ, but cut them obliquely from the front downwards and backwards,

and each one slightly notches the ventral margin on its outer aspect, the notches of successive grooves being more anterior. In very young living shells the grooves are very deep at the anterior margin, so as to form distinctly projecting lamellæ here. The prominent prodissoconch is well preserved as a tiny concentrically hollowed cap.

Cuna delta, Tate and May, sp.

Carditella delta, Tate and May, Trans. Roy. Soc., S. Austr., vol. xxiv., 1900, p. 102.

Cuna delta, Tate and May, Verco, Trans. Roy. Soc., S. Austr., vol. xxxi., 1907, p. 109. See references there.

Dredged also in 104 fathoms, thirty-five miles south-west off Neptunes, and in 130 fathoms off Cape Jaffa, one valve at each station. Its habitat is evidently in the shallower water, not beyond 22 fathoms.

Cuna cessens, n. sp. Pl. xiv., f. 4 to 7.

Shell rather thin, trigonal, almost equilateral. Umbonal angle rather less than a right angle. Apex capped by a minute prodissoconch. Dorsal borders nearly straight, the posterior barely excavate, the anterior barely convex. Anterior and posterior ventral angles well marked. Ventral border convex, not crenulated. Exterior dull, rough, sordid, with about ten obsolete radials; and several concentric imbrications or growth-rests, besides obsolete accremental striation. Anterior and posterior sides somewhat excavate into long lunule and escutcheon, the posterior more deeply than the anterior. The right valve has a large triangular cardinal tooth, and a small posterior above and behind the ligamental pit. The left valve has a large anterior cardinal, and a depression behind the socket of the right wedge tooth for the ligament, separated by a tooth, and a small one above and behind the pit. Each valve has a marginal lateral, and a lateral separated from the margin by a groove. The internal ventral border is not denticulate. The interior is white with the ribs and imbrications visible through the shell. Colour is a dull light horn tint.

Dim.—Antero-posterior diameter, 1·8 mm.; umbo-ventral, 2·1 mm.; sectional, ·9 mm.

Dredged in Backstairs Passage, 22 fathoms, several alive and valves.

Diagnosis.—Its closest ally is *C. delta*, Tate and May; but it is less solid, has a wider umbonal angle, has a smaller sectional diameter, has the concentric rest gradations, and no marginal denticulations.

Type in Dr. Verco's collection.

Cuna concentrica, Hedley.

Cuna concentrica, Hedley, Mem. Austr. Mus., vol iv., 1902, p. 315; Verco, Trans. Roy. Soc., S. Austr., vol. xxxi., p. 109, *q.v.*

Cuna edentata, n. sp. Pl. xiv., f. 1 to 3.

Shell ovate-trigonal, white, glossy, solid. Anterior and posterior lateral borders nearly straight, the latter rather shorter. Ventral border convex, slightly produced anteriorly. A small prominent prodissoconch cap, about three-fourths of a circle. Exterior has crowded concentric valid ribs, but no radial sculpture. The right valve has a large central triangular tooth, a minute anterior, at the extremity of the long antero-lateral tooth, which is separated by a groove from the margin, a marginal postero-lateral, with a minute cardinal tooth above it, and above that a marginal socket for the left posterior cardinal. The left valve has a large anterior cardinal tooth, and a small posterior behind the cartilage-pit, a long low postero-lateral tooth separated by a groove from the margin, and a marginal antero-lateral.

The inner ventral border is not dentated, whence the name.

Dim.—Antero-posterior diameter, 1·6 mm.; umbo-ventral, 1·9 mm.

Hab.—Gulf St. Vincent, dredged several.

Diagnosis.—It is very like *C. concentrica*, Hedley, but the smooth internal ventral border distinguishes it.

Type in Dr. Verco's collection.

Cuna comma, n. sp. Pl. xvii., f. 29 to 31.

Shell solid, white, glossy, obliquely pyriform, with a distinct three-quarter circle prodissoconch. Antero-lateral border convex; postero-lateral concave below the umbo, then straight, much shorter; ventral border convex produced anteriorly. Outer surface closely concentrically ribbed, no radial sculpture. The right valve has a large central curved cuneate tooth in front of the cartilage-pit, and a small posterior tooth just below the umbo, with a little socket outside and below it. The left valve has a large curved anterior tooth, a lamina in front of the cartilage-pit, a small posterior tooth behind the pit, and a small socket above and in front of it. The antero-lateral in the right valve and the postero-lateral in the left are separated from the margin by a groove to receive the corresponding marginal lamina of the other valve. The internal ventral border is not denticulated.

Dim.—Antero-posterior diameter, 2·6 mm.; umbo-ventral, 3·2 mm.

Hab.—Dredged alive in 22 fathoms in Backstairs Passage, and in 20 fathoms off Newland Head; also in Gulf St.

Vincent, very many; in 40, 45, 49, 55, 62, 110, and 130 fathoms, from Beachport to the Neptune Islands, but mostly in poor condition.

Diagnosis.—From *C. concentrica*, Hedley, by its curved lateral and non-denticulated ventral borders; from *C. edentata*, by its larger size and curved lateral borders; from *C. atkinsoni*, by the character of the hinge and the non-denticulated border.

Type in Dr. Verco's collection.

Condylocardia subradiata, Tate, sp. Pl. xvii., f. 25 to 28.

Carditella subradiata, Tate, Trans. Roy. Soc., S. Austr., vol. xi., 1888, pl. xi., f. 7. *Type locality.*—Shell sand, Royston Head.

Dredged off Royston Head, 20 fathoms, one alive, large; Backstairs Passage, 22 fathoms, one alive and six valves; off Beachport in 40 fathoms, fourteen valves; in 49 fathoms, very many valves, good; in 110 fathoms, nine whole and very many valves; in 90 fathoms off Cape Jaffa, many valves; east of North Neptune Island in 45 fathoms, one whole, three valves, all poor; north-west of Cape Borda in 62 fathoms, five alive and many valves, good; thirty-five miles south-west of Neptune Islands in 104 fathoms, four valves, poor. It seems to live in water from 20 to 100 fathoms.

Its generic location has been changed. Tate did not allude to its dentition in his description, and only the external surface was figured. His type, which is the only example in his collection, was fixed on a card to show the outer surface, and was regarded by him as a left *Carditella* valve, produced posteriorly; but it proves to be a right *Condylocardia* valve, produced anteriorly. It has a distinct prodissoconch scale, separated by a narrow groove from the hinge-plate below. A large subcentral cartilage pit is bounded in front by a comparatively long diverging cardinal tooth, and behind by a thinner, lower, and shorter diverging lamina. The long antero-lateral tooth is separated from the margin by a groove, and the postero-lateral tooth is marginal.

Two other valves have furnished the illustrations of the hinge of this species, which may be more fully described thus: accepting Bernard's conclusion for his genus that the anterior is the produced side. The right valve has a diverging front cardinal tooth, and a long antero-lateral separated from the margin by a groove; this receives the antero-lateral marginal lamina of the left valve; this lamina is continued as a sort of hook round the dorsum of the right cardinal, and as a diverging left cardinal down its posterior side, where it rests on a low narrow shelf at the base of, and forms the socket of, the right cardinal and also the anterior wall of

the central cartilage pit. The left valve has a posterior diverging cardinal tooth, and a long postero-lateral tooth separated from the margin by a groove, which receives the postero-lateral marginal lamina of the right valve. The socket of this cardinal is completed by a diverging tooth in the right valve, lying anterior to it, where it rests on a low ledge, and so forms also the posterior wall of the cartilage pit; this is completed dorsally by a horizontal projection forwards from the right posterior cardinal just beneath the edge of the prodissoconch, where there is a horizontal groove in each valve.

Condylocardia compressa, Hedley and May, sp.

Cuna compressa, Hedley and May. Records of the Australian Museum, vol. vii., No. 2, 1908, p. 124, pl. xxiv., f. 29, 30, 31, 32. *Type locality.* 100 fathoms, off Cape Pillar, Tasmania.

Dredged off Beachport in 40 fathoms, three alive and ninety valves; in 49 fathoms, one whole and fifty valves; in 110 fathoms, one whole, twenty-seven valves, several of them poor; in 150 fathoms, twenty-five valves, rather poor; in 200 fathoms, two valves, poor; north-west of Cape Borda in 62 fathoms, twenty-three valves; and off Cape Jaffa in 130 fathoms, one valve. In 40 fathoms would appear to be its real habitat.

It comes very close to *C. subradiata*, Tate, but its greater number of less valid ribs and its more transverse shape when young distinguish it.

I suggested to Mr. Hedley that this species is a *Condylocardia* and not a *Cuna;* and he has re-examined the dentition and concurs in its generic transference. It is comparatively a gigantic species for the genus, which contains (with the exception of *C. subradiata*, Tate) only minute shells.

Condylocardia ovata, Hedley.

Condylocardia ovata, Hedley, Proc. Linn. Soc., New South Wales, 1905, part 4, vol. xxx., p. 539, pl. xxxi., f. 5, 6; Verco, Trans. Roy. Soc., S. Austr., 1907, vol. xxxi., p. 109.

Condylocardia trifoliata, Hedley.

Condylocardia trifoliata, Hedley, Proc. Linn. Soc., 1906, vol. xxxi., p. 475; Verco, Trans. Roy. Soc., S. Austr., 1907, vol. xxxi., p. 109.

Condylocardia pectinata, Tate and May.

Carditella pectinata, Tate and May, Trans. Roy. Soc., S. Austr., 1900, vol. xxiv., p. 103. *Type locality.*—"Derwent Estuary, Tasmania" (W. L. May); Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 435, pl. xxvii., f. 96, 97.

Condylocardia pectinata, Tate and May, sp., Hedley, Mem. Austr. Mus., 1902, vol. iv., part 5, p. 318, "63-75 fathoms, off

Port Kembla, and in Sydney Harbour;" Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xvii. (N.S.), part 1, p. 231, "Dredged off Rhyll, Western Port."

Dredged in 22 fathoms Backstairs Passage, several; also alive and valves in Spencer Gulf and Gulf St. Vincent at unrecorded depths. Taken on Kingston Beach whole and as valves.

Condylocardia porrecta, Hedley.

Condylocardia porrecta, Hedley, Proc. Linn. Soc., New South Wales, 1906, vol. xxxi., part 3, p. 475, pl. xxxviii., f. 24. *Type locality.*—"Mast Head Reef, Queensland."

Dredged Gulf St. Vincent below 22 fathoms, several alive. One small individual has only twelve ribs.

Condylocardia australis, Bernard.

Condylocardia australis, Munier-Chalmas (*nomen*), Bernard; Etudes Comparatives sur La Coquille des Lamellibranches Condylocardia, Paris, 1896, p. 12, pl. vi., f. 4. *Type locality.*—Ile St. Paul (M. Velain).

Dredged Gulf St. Vincent, several whole and valves.

The South Australian shell is scarcely as transverse as that figured, and is more crenulated at the margin, but Bernard describes his as *"margo ventralis crenatus,"* and this character varies in our specimens, as do also the wideness and roundness of the radial ribs.

St. Paul Island, if that situated in the Atlantic is referred to, is very distant; but no further than several other accredited specimens extend.

Condylocardia crassicosta, Bernard.

Condylocardia crassicosta, Bernard; Etudes Comparatives sur La Coquille des Lamellibranches Condylocardia, Paris, 1896, p. ii., pl. vi., f. 1. *Type locality.*—Stewart Island (M. Filhol), New Zealand, taken in 35 fathoms.

Dredged in Backstairs Passage 22 fathoms, several alive; also in Spencer Gulf and Gulf St. Vincent. Received from Mr. C. J. Gabriel, under the name of *C. pectinata*, taken at Frankston, Port Phillip, and Westport Bay. It differs from *C. pectinata* in the smaller number of ribs, seven to ten only, in their greater height, and in the shape of the shell.

EXPLANATION OF PLATES.

Plate XIV.

1. *Cuna edentata*, Verco, exterior.
2, 3. ,, ,, ,, interior.
4. ,, *cessens*, Verco, exterior.
5. ,, ,, ,, side view.
6, 7. ,, ,, ,, hinge.
8. *Venericardia dilecta*, E. A. Smith, exterior.
9. ,, ,, ,, var. *excelsior*, Verco, exterior.

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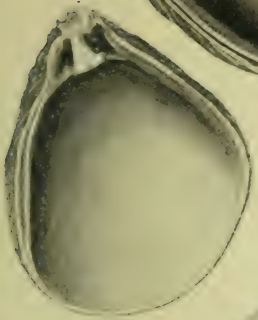

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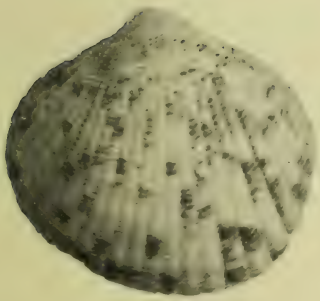

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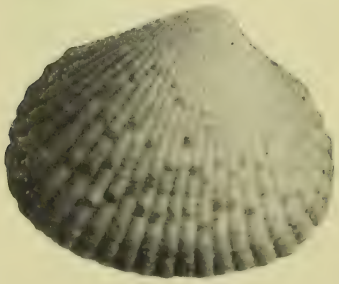

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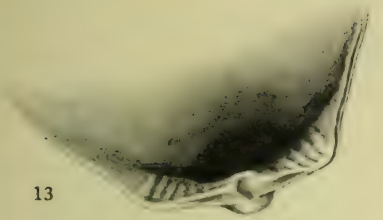

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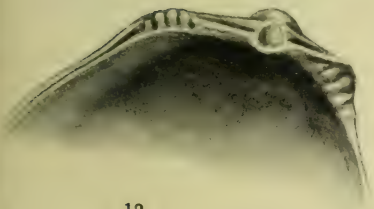

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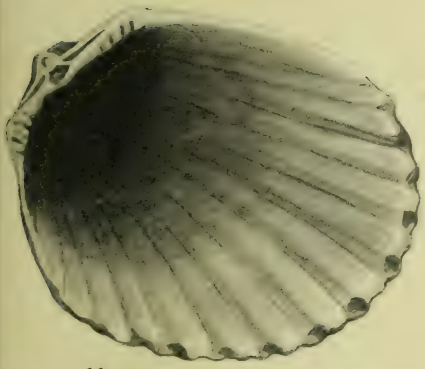

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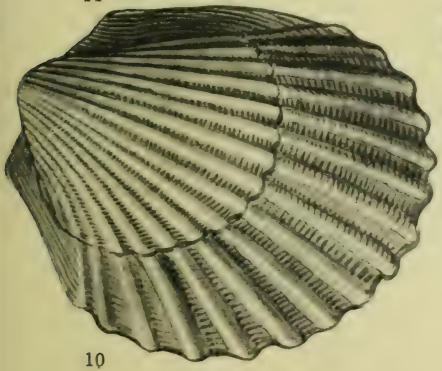

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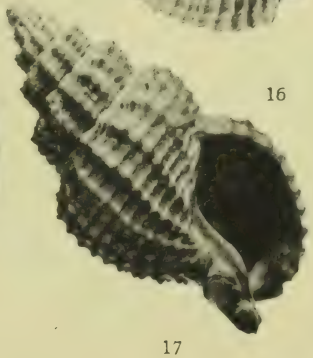

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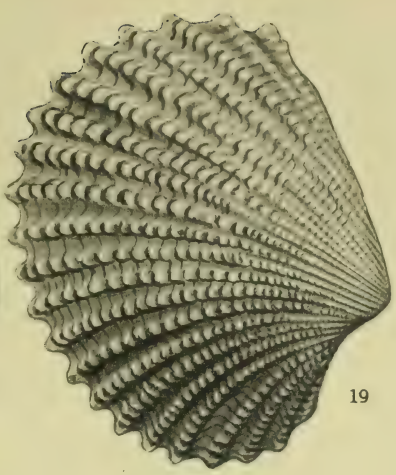

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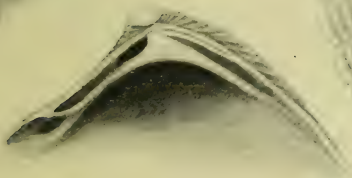

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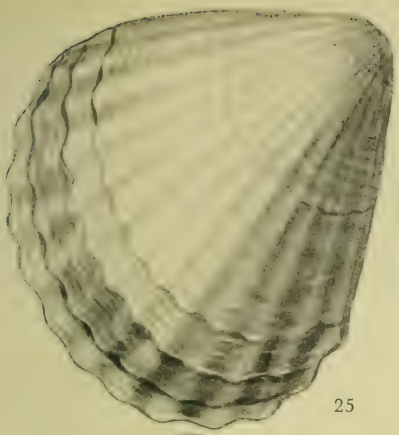

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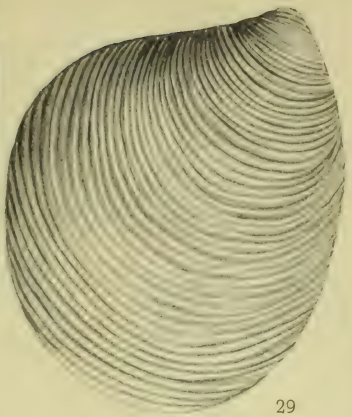

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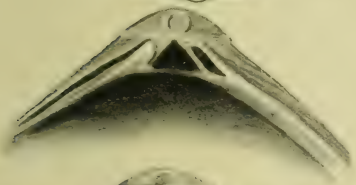

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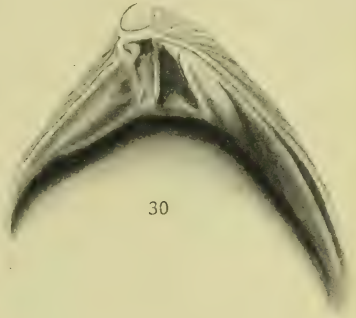

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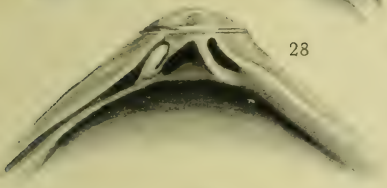

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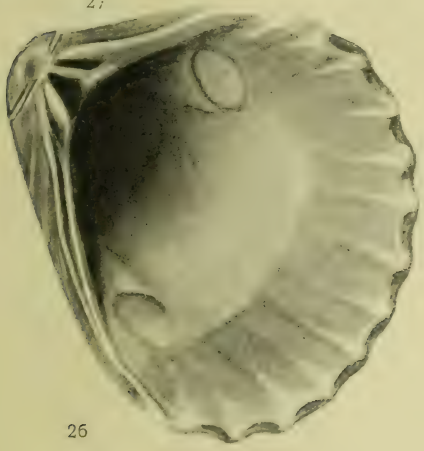

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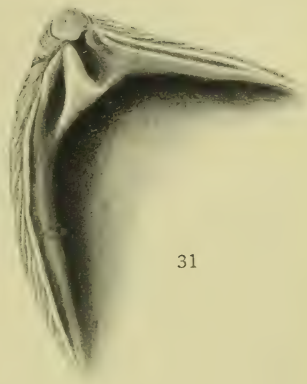

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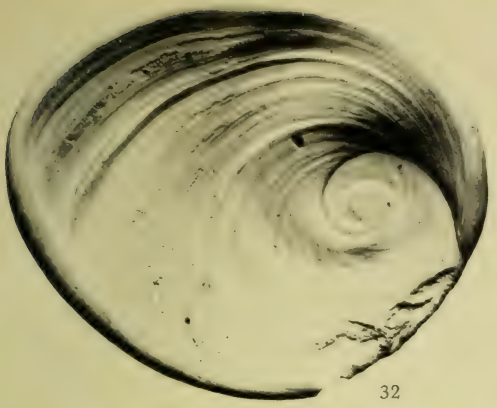

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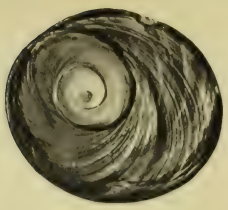

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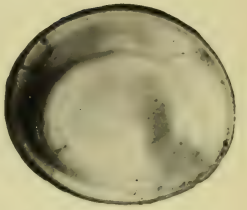

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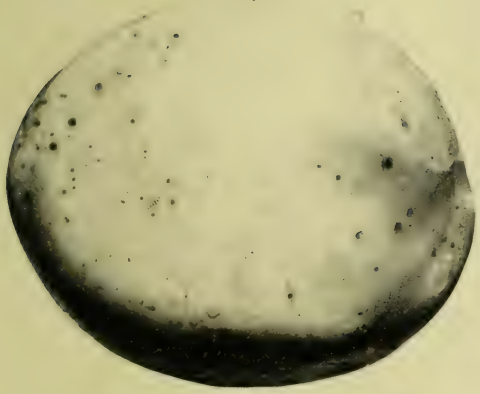

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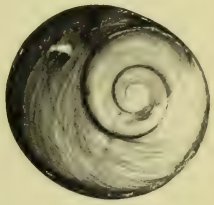

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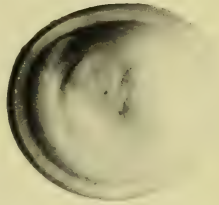

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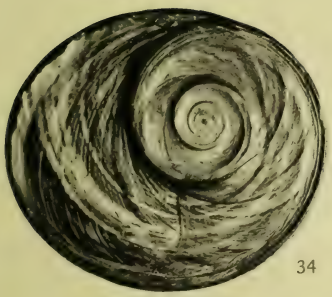

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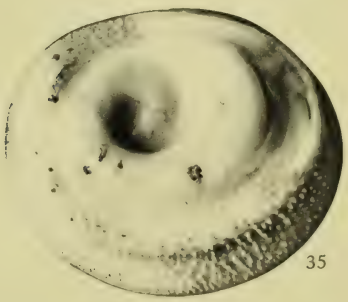

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PLATE XV.

10. *Limæa parvula*, Verco, exterior.
11. ,, ,, ,, interior.
12, 13. ,, ,, ,, hinge.
14. *Turritella kimberi*, Verco.
15. ,, ,, ,, protoconch.
16. *Arcularia grandior*, Verco.
17. ,, ,, ,, a variant to show the aperture.

PLATE XVI.

18. *Venericardia delicata*, Verco, interior.
19. ,, ,, ,, exterior.
20. *Carditella vincentensis*, Verco, exterior.
21. ,, ,, ,, interior.
22. ,, *valida*, Verco, exterior.
23, 24. ,, ,, ,, hinge.

PLATE XVII.

25. *Condylocardia subradiata*, Tate, type shell, exterior
26. ,, ,, ,, ,, interior.
27, 28. ,, ,, ,, not the type shell, showing the hinge.
29. *Cuna comma*, Verco, exterior.
30, 31. ,, ,, hinge.

PLATE XVIII.

32, 33. *Turbo jourdani*, Kiener, operculum.
34, 35. ,, *stamineus*, Martyn, ,,
36, 37. ,, *gruneri*, Philippi, ,,
38, 39. ,, *undulatus*, Martyn, ,,

Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species. No. XXXVIII.

By the Rev. T. Blackburn, B.A.

[Read October 6, 1908.]

CARABIDÆ.

Lithostrotus.

Mr. Sloane, in a note to his tabulation of Australian *Lebiid* genera (Pr. Linn. Soc., N.S.W., 1898, p. 494), suppresses his *Lestianthus* as a synonym of *Lithostrotus*, but without any discussion, nor can I find that he has entered into the matter elsewhere. I cannot now remember whether I have held communication with him on the matter privately, but in any case I think his decision may be accepted, although there are slight differences between his diagnosis and mine which might suggest a doubt on the subject. It seems clear that his *species (L. sculpturatus)* is not identical with my *L. cærulescens*. I have recently met with an example of *Lithostrotus* which does not seem referable to either of the above species, and which therefore must be regarded as a third member of the genus.

L. planior, sp. nov. Minus elongatus, minus convexus; capite quam prothorax parum angustiori; sat nitidus: læte cyaneus, antennis palpis tibiisque rufescentibus; supra pilis erectis sparsim vestitus; capite prothoraceque supra minus fortiter minus sparsim punctulatis; hoc leviter transverso, canaliculato, sat anguste marginato, cordiformi, antice subtruncato, angulis posticis acutis dentiformibus; elytris minus fortiter striatis; striis (his postice sat obsoletis) confertim subtiliter punctulatis, interstitiis planis sat latis uniseriatim sat fortiter sparsius punctulatis. Long., $2\frac{2}{5}$ l.; lat., 1 l. (vix.).

Differs from *L. cærulescens*, Blackb., *inter alia*, by its distinctly less convex form, by its considerably brighter cyaneous colouring, by its head less coarsely and less sparsely punctulate, and by the sculpture of its elytra, which are distinctly striate with the striæ very distinctly, finely, and closely punctulate, the interstices being flat and even, and each bearing a single row of about 10 or 12 strong punctures (much larger than those of the striæ). This species is probably more nearly allied to Mr. Sloane's species than to *L. cærulescens*, but is not likely (on account of several disagreements with the description) to be identical with it, *e.g.*, Mr.

Sloane describes the elytral interstices of his *sculpturatus* as "closely punctulate," which *per se* seems to settle the matter.

New South Wales: Blue Mountains; elevation, 3,000 ft.

LAMELLICORNES.

SERICOIDES.

Platydesmus.

P. (Haplonycha) obscuricornis, Blanch. I have recently met with a *Platydesmus* on the Blue Mountains (New South Wales), which, I feel no doubt, is the true *P. (Haplonycha) obscuricornis*, Blanch. I used the name, with hesitation, in a former paper (Tr. R.S., S.A., 1907, p. 270) for a species of the genus which is closely allied to this Blue Mountain one, but certainly not identical. The present insect is larger, and has its antennal flabellum black or very dark piceous (in both these characters agreeing with Blanchard's description), also has the antennal flabellum of the male longer, the head more closely and less coarsely punctured, and the puncturation of the pronotum distinctly stronger and closer, and the basal joint of the hind tarsi considerably shorter in proportion to the 2nd joint. This discovery leaves the *P. obscuricornis* of my former paper without a name, and accordingly I name and describe it as follows: —

P. punctulaticeps, sp. nov. Mas. Leviter ovatus; sat nitidus; supra subglaber, lateribus ciliatis; subtus pilosus; subiridescens, colore variabilis (ferrugineus, plus minusve picescens); antennis 9-articulatis, rufis, flabello 3-articulato minus elongato (quam clypeus parum longiori) haud arcuato: capite minus crebre minus subtiliter punctulato: prothorace quam longiori ut 13 ad 8 latiori, antice fortiter angustato, supra subtilius minus crebre punctulato, lateribus leviter arcuatis pone medium nonnihil sinuatis, angulis anticis acutis posticis (superne visis) subrectis, basi marginata utrinque sinuata; scutello fere lævi; elytris sat fortiter punctulato-striatis, striis haud geminatim ordinatis, interstitiis sat fortiter convexis sparsim punctulatis; pygidio subtilius minus crebre punctulato; tibiis anticis extus tridentatis (dentibus 2 inferioribus magnis, altero subobsoleto); tarsorum posticorum articulo basali 2° æquali; coxis posticis quam metasternum multo brevioribus.

Feminæ antennarum flabello quam clypeus multo breviori.

The relation of this species to *P. obscuricornis*, Blanch., has been discussed above, under the name of that insect.

New South Wales: Sydney.

The tabulated statement of the distinctive characters of the known *Platydesmi* must now be altered as follows: —

A. Antennal flabellum piceous-black ... obscuricornis, *Blanch.*
A.A. Antennal flabellum red or testaceous.
B. Antennal flabellum has only three laminæ.
C. Basal 2 joints of hind tarsi scarcely differing in length.
D. Pronotum coarsely punctulate sulcipennis, *Macl.*
DD. Pronotum finely punctulate punctulaticeps. [*Blackb.*
CC. Basal joint of hind tarsi notably shorter than 2nd joint.
D. Prothorax fully twice as wide as long ... ... major, *Blackb.*
DD. Prothorax notably less transverse ... ... inamœnus, *Blackb.*
BB. Antennal flabellum has four laminæ inusitatus, *Blackb.*

In a paper which I had the honour of reading before the Royal Society (South Australia) last year I continued my revision of the Australian *Sericoid Lamellicornes* by treating of the group of genera of which *Scitala* may be regarded as the typical member, and also of several aberrant genera which appear to me to follow that group more naturally than to occupy any other place in the aggregate. They complete that portion of the aggregate which consists of winged species having simple claws. In a former paper (Trans. R.S., S.A., 1898, p. 32, etc.) I furnished a tabular statement of the characters of the Australian *Sericoides*, in which I placed at the end of the table seven genera differing from all those preceding them in respect of certain strongly marked characters, inasmuch as they present one or more of the following peculiarities, *viz.*, absence of wings suitable for flight, claws not simple, and prosternal sutures open. The genus distinguished by the lastnamed character *(Mœchidius)* I have since regarded as better placed before the other six of those genera than as the last of the seven, and accordingly I placed it in my present revision as the last of the genera discussed in my paper of 1907. There now remain, therefore, only the genera having claws not simple, which are the "other six" referred to above, and also another genus *(Anacheirotus)* founded by me subsequently (Tr. R.S., S.A., 1900, p. 39) for a very remarkable *Lamellicorn* taken by Herr Koch in Central Australia, and Macleay's genus *Odontotonyx*. The first of these genera *(Callabonica)* calls for some special remark, since I characterized its claws originally (in 1895) as appendiculate, but in 1898 placed it among genera with simple claws, accidentally omitting to add a note setting forth the reasons for the change. The fact is its claws are intermediate in form, and should be called, I think, "subappendiculate."

Their basal part is compressed (and wide on its broader face) and becomes somewhat suddenly narrower a little before the middle (more conspicuously in the front than in the hind claws), but without the sharp distinction between the basal and apical parts that constitutes true appendiculation. In the strict sense, therefore, they must be called simple. *Anacheirotus* was sufficiently discussed by me in a former paper *(loc. cit.)*, and I need not repeat what I then wrote, but it will be well to furnish a fresh tabular statement of the characters distinctive of the *Sericoid* genera still remaining for treatment in this revision, inasmuch as one of them had not been discovered when my former tabulation was written, and I have been able to identify in the Australian Museum another genus *(Odontotonyx)* which in my former revision I was obliged to pass over as unrecognizable.

A. Claws (strictly regarded) simple; membranous wings aborted ... ... Callabonica.
AA. Claws appendiculate or bifid.
  B. Body without membranous wings ... Pseudoheteronyx.
  BB. Winged species.
    C. Antennæ with only 7 joints ... ... Nepytis.
    CC. Antennæ with more than 7 joints.
      D. Anterior 4 tarsi of male strongly dilated ... ... Neoheteronyx.
      DD. Tarsi of male normal.
        E. Tarsi with a large membranous appendage at base of claws Odontotonyx.
        EE. Tarsi not as E.
          F. Form strongly depressed ... Eurychelus.
          FF. Form notably more convex.
            G. Labrum extremely small and inconspicuous ... ... Anacheirotus.
            GG. Labrum strongly developed ... ... Heteronyx.

The known species pertaining to the 8 genera tabulated above are very unevenly distributed, the first 7 genera together containing less than 12 species, while *Heteronyx* is of all the Australian *Lamellicornes* the richest in known species.

Callabonica.

The generic characters have been discussed above under the heading *"Sericoides."* I have not seen any additional specimens referable to *Callabonica* since my original description was written.

Pseudoheteronyx.

I have two new species to be added to this genus. The now known species may be distinguished as follows: —

A. Antennæ of only 8 joints.
  B. Elytra sparsely punctulate (about 12 punctures from suture reach middle of width) ... ... baldiensis, *Blackb.*

BB. Elytra closely punctulate (12 punctures from suture not nearly reaching middle of width) ... ... creber, *Blackb.*

AA. Antennæ of 9 joints.

B. Prothorax twice as wide as long ... laticollis, *Blackb.*

BB. Prothorax decidedly less transverse ... ... helæoides, *Blackb.*

P. creber, sp. nov.. Sat brevis; fortiter convexus; postice dilatatus; minus nitidus; supra sat glaber, subtus et in pedibus pilis fulvis minus sparsim vestitus; niger, antennis palpis tarsisque picescentibus; clypeo crebre ruguloso, antice sinuato-truncato; fronte leviter vix crebre punctulata; prothorace quam longiori fere duplo latiori, antice leviter angustato, supra fortiter crebre punctulato (in parte postico-laterali confluenter subtiliter ruguloso), angulis posticis rotundato-obtusis, lateribus leviter arcuatis, basi media parum lobata; elytris ut prothoracis discus punctulatis, haud striatis; pygidio sparsim punctulato; tibiis anticis extus fortiter 3-dentatis; labro a clypeo obtecto; antennis 8-articulatis; coxis posticis metasterno (hoc sat brevi) longitudine sat æqualibus, quam segmentum ventrale secundum sat longioribus; unguiculis appendiculatis. Long., $6\frac{1}{4}$ l.; lat., $3\frac{1}{2}$ l.

This species is a little more elongate than its previously described congeners, with the metasternum slightly longer. As my specimen is unique I have not been able to examine its concealed parts, but I have no doubt of its wings being obsolete. There are considerably more than 20 punctures down the length of its pronotum, and something like 35 across the width of an elytron.

New South Wales (Mount Kosciusko); taken by Mr. H. J. Carter.

P. laticollis, sp. nov. Brevis; fortiter convexus; modice nitidus; supra fere glaber pilis erectis fulvis sparsissime vestitus; subtus et in pedibus pilis fulvis nonnullis vestitus; niger, antennis palpis tarsisque picescentibus; clypeo crebre ruguloso, antice (superne viso) truncato; fronte minus crebre punctulata; prothorace quam longiori plene duplo latiori, antice leviter angustato supra sparsim acervatim subgrosse vix profunde punctulato, angulis posticis (superne visis) bene determinatis fere rectis; lateribus leviter arcuatis, basi parum lobata; elytris vix manifeste striatis, sparsim sat grosse punctulatis; pygidio sparsissime punctulato; tibiis anticis extus fortiter 3-dentatis; labro a clypeo obtecto; antennis 9-articulatis; coxis posticis metasterno (hoc brevi) longitudine sat æqualibus, quam segmentum ventrale secundum sat longioribus; unguiculis appendiculatis. Long., 6 l.; lat., $3\frac{3}{5}$ l.

Somewhat close to *P. helæoides*, Blackb.; its clypeus viewed from directly above is seen to be truncate (that of *P. helæoides* sinuate or subemarginate); its prothorax is by measurement fully twice as wide as long (that of *P. helæoides* decidedly less transverse); the hind angles of its prothorax viewed from above are quite sharp and almost rectangular (those of *P. helæoides* decidedly blunt); its elytra are all but non-striate, very faint striæ being traceable only from a particular point of view, and there can hardly be said to be distinct continuous interstices between the striæ from any point of view; in *helæoides* 10 distinct striæ are seen, with quite strongly convex interstices—the striæ, however, being rather depressions between ridges than furrows actually impressed on the derm of the elytra, and both striæ and interstices are rendered irregular in places by the foveate rugulosity of the sculpture. In *P. laticollis* about 10 punctures reach from base to apex of pronotum and about 12 from suture to lateral margin of elytra.

New South Wales; taken at Walgett by Judge Docker; sent to me by Mr. Carter.

Nepytis.

As I am not quite sure that I have seen the unique species that represents this genus, I cannot make any confident assertion about its generic validity. I found in Tasmania some years ago a dead and much broken *Lamellicorn* which I believe to be the species in question, but, unfortunately, it is without antennæ, and this particular mutilation renders the specimen incapable of certain identification, as the most distinctive character attributed to the genus is that its antennæ have only 7 joints. I do not regard that character alone as sufficient for separation from *Heteronyx*, although I have not as yet seen any *Heteronyx* with so few antennal joints, but if the specimen referred to above is really *Nepytis*, there are other distinctive characters that establish the validity of the genus. In view of the uncertainty of the identification it is, however, not worth while to go further into the matter here.

Neoheteronyx.

The 4 anterior tarsi of the male in the unique known species of this genus are most remarkable, resembling those of a *Harpalus*. I have nothing to be added here to my former notes concerning it.

Odontotonyx.

This genus is readily distinguished among those having the claws not simple by the large membranous appendage

at the base of the claws. The unique species has elytra nitid, glabrous, and strongly striate.

Eurychelus.

I doubt whether this genus can be permanently retained as distinct from *Heteronyx*. There does not appear to me to be any better character for it than its depressed parallel form and the occurrence on its elytra of a fairly distinct pattern, due to the presence of small patches of whitish pubescence, the derm beneath the patches being also usually of a lighter colour than the general surface. Regarded as a *Heteronyx* the described species (*E. marmoratus*, Blanch.) finds its place in the 1st Group (*vide* my tabulation, to follow), and it stands next to *H. Bovilli*, Blackb., differing from it *inter alia multa* by the very much closer punctuation of its dorsal surface. I have examined a large number of specimens of *Eurychelus* from various localities in New South Wales and Victoria (all of them, I believe, in mountainous regions), and am unable to regard them as representing more than one species, which, however, seems to be variable in several respects, especially size (long., $3\frac{3}{4}$-$5\frac{1}{2}$ l.) and colouring, the usual colour being ferruginous marbled with slightly lighter patches bearing short whitish hairs. In many specimens the disc of the pronotum is blackish. In the most highly coloured example before me the elytra are piceous, with most of the suture as well as the paler blotches very conspicuously testaceous, and the legs bright ferruginous. Some examples from Mount Kosciusko (sent by Mr. Carter) are darker than the usual type—one of them with black elytra—and the marbling of the elytra is more or less obsolete. The sculpture scarcely varies—only, I think, to the extent of the pronotum being a little less closely punctured in some specimens than others, but the varieties are found in company with each other, and are very likely to be the sexes.

Anacheirotus.

I have not seen any more species or specimens of this genus since I characterized it eight years ago. It is probably found only in the dry central regions of Australia which are seldom visited by entomologists. The validity of the genus will probably stand permanently, for it is scarcely likely that intermediate forms will be found linking the small inconspicuous labrum of *Anacheirotus* with the large prominent labrum of a typical *Heteronyx*.

Heteronyx.

This genus might reasonably claim to be the most perplexing to the student in the whole range of the Australian

Coleoptera, its hundreds of species being all of them obscure insects of uninteresting appearance, closely allied *inter se*, almost devoid of reliable distinctive colouring, and burdened with numerous names attached by the earlier authors to descriptions that are practically useless. I wrote a revision of the genus as then known to me in Proc. Linn. Soc., N.S.W. (1888 and 1889), but that work now stands in need of being superseded by a new revision, owing to the large number of additional species that have found a place in collections during recent years, most of which are as yet undescribed. The paper of which I now offer the first portion is an attempt to meet that want, and will complete the series of papers on the Australian *Sericoides* which I have laid before the Royal Society of South Australia during the last three years.

In my former revision of *Heteronyx* (founded by M. Guérin-Méneville, 1830) I entered somewhat fully into the history and synonymy of the genus. Subsequent investigation has not materially affected the conclusions set forth in that paper, although it has added information of certain generic forms that have since been characterized, and has yielded additional information about synonymy. The statement that I did not know any Australian *Sericoides* except *Heteronyx* having in combination elytra of normal length, antennæ of 8 or 9 joints, and claws not simple cannot, of course, now be repeated in the present tense, inasmuch as I have since formed 3 new genera *(Pseudoheteronyx*, *Neoheteronyx*, and *Anacheirotus)* having those characters, for certain species that have come into my hands since I made the statement referred to. Moreover, a recent examination of the collection of Mr. W. S. Macleay, in the Macleay Museum at Sydney, points to the probability of the name *Cotidia* being a synonym of *Heteronyx (vide* Tr. R.S., S.A., 1907, p. 244). I have already in this paper pointed out that the genus *Callabonica* was erroneously placed by me *(vide* Tr. R.S., S.A., 1895, p. 36) beside *Heteronyx*. With these qualifications the general remarks on the characters and synonymy of *Heteronyx* (which, however, did not include reference to *Callabonica*, a name of later date) in my former revision of the genus do not appear to me to need alteration. For the characters of the recently added genera (mentioned above) it is easy to refer to their diagnoses in former volumes of our Transactions, and their relation to *Heteronyx* is indicated also in tabular form in Tr. R.S., S.A., 1898, p. 34, and 1900, p. 40. It will be convenient here to recapitulate briefly the conclusions in respect of synonymy set forth in my former revision, but it is unneces-

sary to burden this paper with a repetition of the reasons already stated which led me to those conclusions. I expressed the opinion that the generic names which I can ascertain to have been regarded by Lacordaire and other authors as synonyms of *Heteronyx* ought to be treated as follows: —

Caulobius and *Haplopsis* as distinct valid Australian genera.

Homaloplia and *Philochlœnia* as not occurring in Australia at all (the species which Lacordaire rightly regarded as incorrectly referred to them are not *Heteronyces*, as he took them to be).

Sericesthis as a valid distinct genus, though possibly one or two of the species Boisduval referred to it may have been *Heteronyces*.

Silopa and *Hostilina* as synonyms of *Heteronyx*.

Melolontha as not occurring in Australia, although the name was applied by early authors to some species of *Heteronyx*.

Cotidia (referred to above) also seems to be probably a synonym of *Heteronyx*.

I pass now to some general remarks on the grouping of the *Heteronyces* in aggregates. I have failed to find any character that will avail for this purpose so as to produce "natural" groups, *i.e.*, groups the members of which can be rightly regarded as on the whole more nearly allied to each other than they are to the members of other groups. Whether the structure of the antennæ, or of the labrum and clypeus, or of the claws, or of the coxæ (in all of which organs the diversity of form is very great and extremely interesting) be taken as the basis of classification, the result is always that species closely agreeing in facies are widely separated, and if the species resembling each other in facies be grouped together, each of the groups so formed is found to contain the widest possible diversity of structure in almost every organ of the body. I therefore arrive at the conclusion that, to me at any rate, the grouping of the *Heteronyces* must be a mere matter of convenience for the purpose of identification, and consequently I content myself with the effort to place the species in aggregates which will serve best to that end. This view of the matter is similar to that which I expressed in my former series of papers on the genus, and in the main my recent study of the subject, founded on a vastly increased quantity of material, has confirmed in my judgment the conclusions I then set forth as to the method that it is best to follow in forming these artificial groups. I have found, however, that one important modification of my former scheme is

desirable. While still convinced that the character lending itself best to the formation of primary groups and doing least violence to natural affinities is the relation of the labrum to the clypeus, I have found that it is undesirable to retain the second of the three primary groups for which I employed it in my former series of papers, and which was characterized as having the relation to each other of the labrum and clypeus intermediate between their relation in the other two groups. The first essential in the artificial grouping of an extensive series of species is to form the primary aggregates in such fashion that there can be no doubt at all in distributing the species among them. In my former classification I divided the species into those having the labrum entirely below the level of the clypeus, those having the summit of the labrum on a level with the clypeus, and those having the clypeus below the level of the summit of the labrum. Working through the long series of undescribed species now in my hands, I have found that the transition of the position of the summit of the labrum is very gradual, so that in not a few species that would have to be placed in the intermediate group the relation of the labrum to the clypeus would differ very little indeed from its relation in species that would fall into one or other of the other two groups. I therefore propose to abolish the second primary group altogether, and to distribute its species between what I formerly called the first and the third groups, expressing, however, the characters that distinguish those groups (now the first and second) in altered terms, for the comprehension of which a little explanation is necessary. In a very large majority of the *Heteronyces* (including the whole of the group formerly called the third) the relation of the labrum to the clypeus is such that if the head be looked at somewhat obliquely from behind, the middle part of the free outline of the head is the labrum, and that that part is a convex curve distinct from the curve of the clypeus on either side of it, so that the free outline of the head appears trilobed, or at least trisinuate. There is the greatest possible specific diversity in the nature of this outline in other respects—the middle lobe or arch (*i.e.*, the labrum) varying from being much more than a third of the whole free outline, to being little more than a narrow inequality in the curve of the free outline (in some instances conspicuous only from certain points of view), and from being but little projected forward (so that the summits of the clypeal curves reach forward considerably more than it does) to being a conspicuous proboscis-like lamina protruding from the front of the head; but in all the species which I group together by this character there

is the invariable threefold convexity of the free outline of the head when that segment is looked at from the required point of view (more or less obliquely from behind). In the other primary group of *Heteronyces* this threefold convexity of the free outline of the head (which I call in the following pages the "trilobed outline") is altogether wanting. In the majority of its species the whole labrum is much below the level of the clypeus, so that the whole free outline of the head is clypeus (as in *Scitala* and most other *Sericoid* genera), while in some species the labrum (the head being regarded obliquely from behind) is visible in a deep emargination of the clypeus where its outline appears as a *concave* curve: in some species the ends of the labrum only are visible projecting from the outline as two more or less conspicuous processes, and in some the clypeus has a deep angular cleft in which the labrum is not any part of the outline from any point of view that looks obliquely at the head from behind; but always the free outline of the head has no appearance of threefold convexity. When the *Heteronyces* are thus divided into primary groups there are scarcely any species at all about whose location there can be the slightest doubt. The only instances known to me are those of a few small species in each group in which from a certain point of view the outline is in a sense trilobed, but the middle lobe (the labrum) from that point of view presents a truncate apex. In two or three of these species the trilobed appearance is caused merely by the labrum being projected so far forward without overtopping the front margin of the clypeus that it comes into view. These species belong to the first group. In the other species referred to the labrum overtops the front margin of the clypeus, and the truncate appearance of its apex when viewed obliquely from behind is due to an exceptional structure of the labrum itself, and consequently these insects stand in the second group. It may here be noted that the first group contains no species in which the labrum overtops the front margin of the clypeus. For the sake of brevity in tabulating I call the lobes of the trilobed outline simply "middle lobe" and "lateral lobes," omitting the words "of the trilobed outline," and also in comparing the width of the lobes omit the words "in width" (*e.g.*, "middle lobe more than ½ lateral lobes," meaning that it is more than ½ as wide as each lateral lobe).

For the formation of secondary groups I take the number of joints in the antennæ—a character which does not call for any further remark. Finally, I divide each of the aggregates resulting from the use of the two characters already mentioned into two groups, according as the claws of

the hind tarsi are bifid or appendiculate, and on this division it will be necessary to furnish some notes, inasmuch as there is wide diversity in the form of the claws which I call bifid, and it is not difficult to arrange a series of *Heteronyces* in such fashion that the appendiculate form seems to pass very gradually to the bifid, requiring a definite statement (if the terms are to be of value for identification of species) of exactly what is covered by each term. If a species with typically appendiculate claws be examined it will be seen that each hind claw consists of two pieces—a basal compressed piece (which approximates in form to a parallelogram) and a much more slender apical piece attached to the external apex of the basal piece. Transition from that typically appendiculate build of claw to the bifid may be said to begin by a tendency of the inner apex of the basal piece to be prolonged more or less at an angle to the axis of the basal piece, and that tendency becomes gradually in successive species more pronounced until the prolongation becomes a well-defined sharp process not much less than half the size of the whole apical piece. When the point is reached of the prolongation being more than a trifling prominence of the inner apex of the basal piece (say, less than a quarter of the projection of the apical piece) I call the claw bifid, as it then seems to end in two processes not very greatly different in size. A variation of this latter form is found in some species where the apical piece itself is extremely small and the inner apex of the basal piece is produced like a triangular tooth scarcely at all smaller than the whole apical piece. Next we find a form in which the claw appears to consist of a single piece ending in a sharp slender curved process and having a tooth-like process projecting from its inner margin at a greater or less distance from the base, and finally the genuinely bifid form is reached where the apex of the claw is seen to be split into two somewhat equal portions—usually both small. Thus it will be seen that, in the following pages, an appendiculate claw is taken to be one having a basal compressed piece of which the apex is more or less truncate, and the inner apical angle not or very little projected, and a slender piece attached to the external apical angle of the basal piece, and that all other claw structure is regarded as bifid. It should be noted that in many species of *Heteronyx* the claws when appendiculate look from some points of view as if they were simple, and therefore require to be examined carefully.

The shape of the labrum calls for close attention in discriminating the species of *Heteronyx*. This organ presents—I think in all the species—the common character of being so formed that its dorsal surface may be regarded

as two planes meeting each other, one of which (I call it the lower plane) is inclined from the line of junction with the other (which I call the upper plane) hindward and downward (the insect being laid on its back) towards meeting the labium; the upper plane is inclined from the line of junction upward or horizontally towards the front edge of the clypeus. But outside this common feature of the labrum there is the greatest possible diversity. In some species the upper and lower planes meet at an angle, the line of junction in some species even being defined by a fine transverse carina; while in others the two planes meet in a rounded manner. In some species the upper plane is horizontal, in others perpendicular, or inclined in diverse ways to the horizontal. In some species the labrum is entirely below the level of the clypeus, in others it overtops the clypeus. In some species having the labrum entirely below the clypeus, but more or less perpendicular, it appears when viewed from the front as an arch of uniform height, in others as an arch much more strongly curved on the upper than the lower edge, in others as a triangle, and in others again as an elongate erect lamina.

The puncturation of the various segments of the body is, of course, a character of great importance in distinguishing the species of this genus—but it is obviously difficult to express in terms that lend themselves to a tabular statement where the difference in puncturation is not very great. In the following pages I have in some cases endeavoured to meet that difficulty by counting the number of punctures occupying a given space, and I have also made use of a difference that is easily traceable in the type of puncturation on the elytra. In many species the punctures are isolated round holes, normally impressed on the surface, while in others they appear as impressions of more or less triangular form, more deeply sunk at the base than at the apex, with the result that if the elytra be viewed obliquely from behind the front limit of the punctures seems to be raised in a granuliform manner. The term "squamose" has been commonly applied to that latter style of sculpture from its causing a more or less scale-like appearance from some points of view, and I have made use of the term in the following pages. It is desirable, however, to remark that I limit the term to those elytra in which the *prevailing* character of the sculpture is squamose; there are some species in which the general puncturation is distinctly of the non-squamose type, but on which, nevertheless, when they are viewed obliquely from behind a few granules can be seen—usually about the base and suture. It is perhaps well to note here that where a

number of punctures is mentioned as occupying a given distance, the meaning is that that number of punctures averagely spaced *would* occupy that distance if they ran regularly in line. Thus the statement that about ten punctures from the apex reach to the middle of pronotum means that the punctures are so spaced that if ten of them averagely spaced were placed on a straight line down the middle of the pronotum they would reach to about the middle of the segment; as a fact, the punctures very seldom do run in straight lines, and where the puncturation is sparse a right line down the middle of the pronotum might actually touch very few of the punctures, passing between most of them.

This expedient of indicating specific characters by counting the punctures is, of course, available only in the case of the difference of puncturation being considerable, and, moreover, does not serve for notifying the relative *fineness* or otherwise of the punctures. It is, however, essential, if the distinctive characters of a great number of species such as compose *Heteronyx* are to be intelligently cast into a tabular form, that no character be passed over which can by any means be indicated with definite clearness, and therefore I have adopted the expedient of selecting certain species as standard species with which others may be compared, choosing those which are the most widely distributed and the most easily identified. There are three *Heteronyces* which from their distribution might be confidently expected to be present in any collection including a fair number of species from New South Wales, Victoria, South Australia, and Western Australia, all of which can be named without much difficulty—at any rate, can be identified with the insects to which I in this revision apply the names. *H. obesus*, Burm., is found in all the places named above, and has no very close ally known to me. *H. jubatus*, Blackb., is a common species in New South Wales, Victoria, and South Australia, and is easily identified by the characters given in my former revision (Proc. Linn. Soc., N.S.W., 1889, p. 662) or in the tabulation to follow in this present revision, and, moreover, its only near allies (*H. fallax*, Blackb., and *H. striatipennis*, Blanch.) have elytra similarly punctured. *H. elongatus*, Blanch., is common in New South Wales, and is at once identified among its nearer allies by the conspicuous pencil of long fine setæ at the inner apex of each elytron. I shall not hesitate, therefore, to indicate distinctions of puncturation by comparison with those species. For the sake of brevity I shall not hold it necessary to quote the authors' names when I have occasion to refer to those species.

It is, perhaps, well to specify that the ventral segment, which in this memoir I call the "first" or "basal," is that which is (except in a very few species) partially overlapped by the hind coxæ, and that consequently the "second" ventral segment is the first which is entirely free of the hind coxæ. These are the first and second that are visible on the middle line.

I now pass to the discussion of the species of *Heteronyx*, which I divide into 8 groups, as follow: —

A. Front outline of head (viewed obliquely from behind) not presenting a threefold convexity.
  B. Antennæ consisting of only 8 joints.
    C. Claws bifid ... ... Group I.
    CC. Claws appendiculate ... ... Group II.
  BB. Antennæ consisting of 9 joints.
    C. Claws bifid ... ... Group III.
    CC. Claws appendiculate ... ... Group IV.
AA. Front outline of head (viewed obliquely from behind) presenting a threefold convexity.
  B. Antennæ consisting of only 8 joints.
    C. Claws bifid ... ... Group V.
    CC. Claws appendiculate ... ... Group VI.
  BB. Antennæ consisting of 9 joints.
    C. Claws bifid ... ... Group VII.
    CC. Claws appendiculate ... ... Group VIII.

Some of the above groups lend themselves to further division into subgroups, which will be found characterized under the headings of the several groups. In the present paper I am able to deal with only the species of the first two groups, but I hope to offer a paper to the Society next year completing this revision of the genus.

It is well to add the note that I am unable to specify any satisfactory character by which the sex of a *Heteronyx* can be confidently determined. The ventral segments in the male form a flat surface, so that their outline viewed from the side appears as a straight line. That outline is convex, I think, only in females. In some species the basal joint of the hind tarsi shows slight sexual distinctions, but so slight as to be valueless for description.

Group I.

The *Heteronyces* of this group are comparatively few in number, and they are all rare in collections. I have before me more than one specimen of only three species, and more than two specimens of only one species. I cannot associate with this group any of the names given by the earlier authors except Blanchard's name *rubescens*, and I should not have ventured on that identification if I had not been assisted by the possession of specimens from the original locality (Kan-

garoo Island). Blanchard, unfortunately, does not describe the claws of any of his *Heteronyces*. *H. rubescens*, in my former revision, was placed in the "intermediate" (now abolished) main division of the genus, on account of its labrum being slightly visible as part of the free outline of the head, but appearing (when so seen) concave, and not rising to the level of the clypeus. The following tabulation shows the distinctive characters of the species of this group: —

A. Lateral gutter of pronotum distinctly expanded and flattened out close to front margin.
  B. Hind projection of hind claws much smaller than the whole apical piece.
    C. Hind projection of hind claws much nearer to apex of claw than to base of claw.
      D. Elytra not or scarcely granulate.
        E. Punctures of elytra well defined and isolated.
          F. Elytral punctures somewhat close (many more than 17 across an elytron).
            G. Basal edging of pronotum conspicuously thickened and raised at its ends ... fulvohirtus, *Blackb.*
            GG. Basal edging of pronotum uniform or nearly so litigiosus, *Blackb.*
          FF. Elytral punctures very few (about 17 across an elytron) rudis, *Blackb.*
        EE. Punctures of elytra indistinct (in antero-lateral part lost in subconfluent rugulosity) ... dispar, *Blackb.*
      DD. Elytra uniformly and conspicuously granulate ... ... rubescens, *Blanch.*
    CC. Hind projection of hind claws scarcely nearer to apex of claw than to base of claw ... ... Tepperi, *Blackb.*
  BB. Hind projection of hind claws not or scarcely smaller than the whole apical piece.
    C. Middle part of summit of labrum projects from perpendicular front of clypeus.
      D. Elytra non-striate outside subsutural stria.
        E. Elytra granulate.
          F. Prothorax very little narrowed in front ... ... squalidus, *Blackb.*
          FF. Prothorax much narrowed in front ... ... Doddi, *Blackb.*
        E. Elytra not granulate ... ... Bovilli, *Blackb.*
      DD. Elytra with 6 or 7 quite distinct striæ ... ... anomalus, *Blackb.*
    CC. Middle part of summit of labrum closely applied to perpendicular front of clypeus ... ... labralis, *Blackb.*
AA. Lateral gutter not expanded in front advena, *Blackb.*

H. litigiosus, sp. nov. Sat elongatus, postice parum dilatatus; sat nitidus; brunneus, antennis palpisque testaceis; pilis cinereis brevibus minus dense vestitus; clpeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte sat grosse nec crebre punctulata, fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 11 ad 6 latiori, antice modice angustato, supra fortiter nec crebre punctulato (puncturis circiter 14 in segmenti longitudine), lateribus leviter arcuatis, angulis anticis acutis minus productis posticis (superne visis) acutis retrorsum directis, basi fortiter bisinuata, margine basali æqualiter elevato; elytris concinne sat fortiter punctulatis (trans elytron puncturis circiter 25); pygidio sparsim sat grosse nec profunde punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us multo breviori (3° sat æquali); unguiculis leviter bifidis. Long., 5 l.; lat., 2½ l.

Near *H. fulvohirtus*, Blackb., but distinguishable as indicated in the tabulation. It also differs by its more strongly emarginate clypeus, its frons much less closely punctulate, its elytra less coarsely and less sparsely punctulate. The claws of this species are not strongly removed from the appendiculate type, but the basal piece is too strongly dentiform at its inner apex to allow of the claws being called appendiculate. If they were regarded as appendiculate the quite strongly subangularly emarginate clypeus would readily distinguish this species from those near which it would fall in the tabulation of Group II.

Western Australia; Nullabor Plains (given to me by Mr. French).

H. rudis, sp. nov. Minus elongatus, postice vix dilatatus; sat nitidus; testaceo-brunneus, pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice in media parte minus perspicue emarginato; labro summo clypei planum nullo modo attingenti; fronte fortiter vix crebre punctulata; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 19 ad 11 latiori, antice leviter angustato, supra sparsius inæqualiter subgrosse punctulato (puncturis circiter 12 in segmenti longitudine), lateribus leviter arcuatis pone medium (superne visis) subsinuatis, angulis anticis acutis modice productis

posticis (superne visis) acutis sat fortiter retrorsum directis, basi fortiter bisinuata, margine basali sat æqualiter elevato; elytris concinne grosse punctulatis (trans elytron puncturis circiter 17); pygidio leviter sparsim minus fortiter punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um paullo longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us sat breviori quam 3us paullo longiori; unguiculis leviter bifidis. Long., 4 l.; lat., 2½ l.

A very coarsely and sparsely punctured species, in this respect resembling *H. crassus*, Blackb. (Group VI.), but having elytral sculpture still coarser. Its claws resemble those of the preceding species (*H. litigiosus*). If the claws were regarded as appendiculate its coarse, sparse puncturation would readily distinguish this species from those near which it would fall in Group II.

Western Australia; Murchison district.

H. dispar, sp. nov. Modice elongatus, postice parum dilatatus; sat nitidus; brunneus, antennis palpisque dilutioribus, pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte fortiter nec crebre punctulata; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 18 ad 11 latiori, antice leviter angustato, supra sparsius sat fortiter punctulato (puncturis circiter 14 in segmenti longitudine), lateribus sat rotundatis pone medium (superne visis) subsinuatis, angulis anticis acutis sat productis posticis (superne visis) vix acutis vix retrorsum directis, basi fortiter bisinuata, margine basali sat æqualiter elevato; elytris confuse (fere subsquamose) minus fortiter punctulatis (trans elytron puncturis circiter 28), puncturis per asperitatem obscuram minus perspicuis; pygidio sparsim nec fortiter punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us parum breviori quam 3us sublongiori; unguiculis leviter bifidis. Long., 4 l.; lat., 2 l.

This species, with the preceding two, and *fulvohirtus*, Blackb., and *rubescens*, Blanch., form a small aggregate of species evidently allied naturally *inter se*, but with very good distinctive characters, as indicated in the tabulation. Of the 5, this species and *H. litigiosus*, Blackb., are the two

nearest to each other. They are quite distinct, however, by the prothorax of *H. dispar*, with its sides quite strongly rounded and its hind angles (viewed from above) notably blunter, as well as by the sculpture of the elytra, on which the punctures in *dispar* are indistinct owing to an ill-defined roughness of the derm, so that in parts it is not easy (in the antero-lateral part quite impossible) to pick out the individual punctures, they having quite a blurred appearance. The difference between the puncturation of the pronotum and that of the elytra consequently is very great in *dispar*, the latter appearing close and obscure, in strong contrast to the sparse, well-defined appearance of the former. The claws of *dispar* are much like those of *litigiosus;* if they were to be regarded as appendiculate the clypeus and frons resembling those of *litigiosus* would readily prevent the confusion of the species with any of those in Group II.

South Australia; Eucla.

H. squalidus, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; brunneus, antennis palpisque testaceis; pilis fulvis brevibus minus dense vestitus; clypeo brevi, confluenter ruguloso, antice vix sinuato late truncato-rotundato, labro summo clypei planum haud attingenti; fronte subgrosse sat crebre punctulata; fronte clypeoque planum fere æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 19 ad 11 latiori, antice minus angustato, supra fortiter minus crebre punctulato (puncturis circiter 16 in segmenti longitudine), lateribus arcuatis, angulis anticis acutis minus productis posticis (superne visis) obtusis, basi obsolete bisinuata, margine basali sat æqualiter elevato; elytris subtiliter granulatis, subtiliter sat crebre squamose punctulatis (trans elytron puncturis circiter 30); pygidio sparsius subtilius punctulato; coxis posticis quam metasternum paullo brevioribus quam segmentum ventrale 2um sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us sat breviori, quam 3us sat longiori; unguiculis bifidis. Long., 4 l.; lat., 2 1-10 l.

Easily distinguished from all the species placed before it in the tabulation by the base of its pronotum scarcely sinuate, as well as by the obtuse (though quite distinct) hind angles of that segment. The sculpture of its elytra resembles that of *H. rubescens*, Blanch., but is finer and closer. It differs from *rubescens*, *inter alia*, by the notably closer and stronger puncturation of its pronotum.

Central Australia (Dr. Symonds). The type is in the South Australian Museum.

H. Doddi, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; brunneus, antennis palpisque dilutioribus; pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte crebre subgrosse punctulata; fronte clypeoque ut plana sat disparia visis (illa leviter convexa); antennis 8-articulatis; prothorace quam longiori ut 7 ad 4 latiori, antice sat fortiter angustato, supra fortiter vix crebre punctulato (puncturis circiter 16 in segmenti longitudine), lateribus sat rotundatis, angulis anticis acutis sat productis posticis (superne visis) obtusis, basi obsolete bisinuata, margine basali æqualiter elevato; elytris subtiliter granulatis, sat subtiliter sat crebre squamose punctulatis (trans elytron puncturis circiter 27); pygidio leviter sparsim punctulato; coxis posticis quam metasternum paullo brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus sat fortiter tridentatis; tarsorum posticorum articulo basali quam 2us multo (quam 3us manifeste) breviori; unguiculis bifidis. Long., $3\frac{1}{2}$ l.; lat., $1\frac{4}{5}$ l.

This is a very distinct species, but evidently allied to *H. squalidus*, Black. Apart from its smaller size, it differs from that insect in many respects—notably by the quite strong emargination of the middle of its clypeal outline, and in the much greater anterior narrowing of its prothorax. Its elytral sculpture is a little less fine and less close. The claws of both are unmistakably bifid.

Southern Queensland (Dodd). Given to me by Mr. Griffith.

H. anomalus, sp. nov. Minus elongatus, postice sat fortiter dilatatus; sat nitidus; rufus, capite supra elytris segmentisque ventralibus piceis; pilis brevibus fulvis minus dense vestitus; clypeo fronteque grosse crebre sat rugulose punctulatis, illo antice nullo modo emarginato; labro summo clypei planum nullo modo attingenti; fronte clypeoque ut plana sat disparia visis (illa leviter convexa); antennis 8-articulatis; prothorace quam longiori ut 15 ad 8 latiori, antice mox pone marginem sat fortiter antrorsum angustato, supra sat fortiter sat crebre punctulato (puncturis circiter 22 in segmenti longitudine), lateribus leviter rotundatis, angulis anticis vix acutis leviter productis posticis (superne visis) rotundato-obtusis, basi vix bisinuata; elytris striatis, fortiter sat crebre punctulatis (trans elytron puncturis circiter 24),

interstitiis convexis; pygidio sat fortiter sat crebre subrugulose punctulato; coxis posticis quam metasternum multo brevioribus, quam segmentum ventrale 2um parum longioribus; tibiis anticis extus minus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us parum breviori, 3° sat æquali; unguiculis bifidis. Long., 4 l.; lat., 2 l.

This species has scarcely the facies of a *Heteronyx*, being of more robust build and brighter colouring than is usual in the genus, but I can find no structural character by which to separate it; its being unique in my collection, however, is a hindrance to the exploration of its characters. It is the only species known to me appertaining to this group and having decidedly striate elytra. The striation, however (as usual when present in *Heteronyces*), is of a special type, not affecting the elytral puncturation, and consisting of the intervals between obscure longitudinal obtuse ridges rather than true striæ. The prothorax has a massive appearance, being scarcely narrowed till close to the front margin, where it becomes *much* narrower suddenly. The labrum projects from the perpendicular front of the clypeus only feebly.

New South Wales; Tamworth district (Musson).

H. labralis, sp. nov. Modice elongatus, postice sat dilatatus; sat nitidus; brunneo-testaceus; pilis brevibus fulvis minus dense vestitus; clypeo fronteque grosse sparsim punctulatis, illo antice truncato sat fortiter reflexo; labro summo a superficie clypei antica perpendiculari haud projecto; fronte clypeoque ut plana multo disparia visis (illa convexa); antennis 8-articulatis; prothorace quam longiori ut 15 ad 8 latiori, antice sat angustato, supra sat crebre vix fortiter punctulato (puncturis circiter 20 in segmenti longitudine), lateribus sat rotundatis, angulis anticis sat acutis sat productis posticis (superne visis) rotundato-obtusis, basi obsolete bisinuata, margine basali fere æqualiter elevato; elytris concinne subtilius punctulatis (trans elytron puncturis circiter 30); pygidio (exempli typici unici) haud observato; coxis posticis quam metasternum multo brevioribus, quam segmentum ventrale 2um vix longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali 2° sat æquali, quam 3us paullo longiori; unguiculis bifidis. Long., 4 l.; lat., 2 l.

The summit of the labrum applied (and I think soldered) to the perpendicular front face of the clypeus easily distinguishes this species. Apart from that character it

would stand in the tabulation beside *Bovilli*, Blackb., from which it differs *inter alia multa* by the much closer punctuation of its dorsal surface. The omission of description of the pygidium is due to that segment being unnaturally drawn up under the elytra in such fashion that it could not be examined without damaging the specimen.

New South Wales; Picton. Given to me by Mr. Griffith.

Before passing to the consideration of Group II. it seems desirable to remark on two or three species described by the earlier authors, which seem to be possibly attributable to this group.

H. spadiceus, Burm. The description of the clypeus does not indicate quite clearly (though I take it to have that meaning) that the clypeus is overtopped by the labrum; if that is the case this species falls into my Group V. or VI., if not, it belongs to this or the second group, in neither of which have I seen any species presenting the characters Burmeister indicates, *viz.*, labrum conspicuous in front of the clypeus, surface entirely grabrous and nitid. Long., 4 l. (from Western Australia).

H. unguiculatus, Burm. This species probably belongs to the present group, although it is not quite clear whether it may not be a member of Group V. In Group I. its front tibiæ with only two distinct external teeth separate it strongly from all the species known to me, except *Tepperi*, Blackb., from which it differs, *inter alia*, by its claws "*tief gespalten*" at the apex.

H. rotundiceps, Blanch., seems to be a member of either this group or Group II., according as its claws (which are not described), are bifid or appendiculate. It appears to be distinguished from all the species known to me of those groups by its being an iridescent insect, and iridescence is so extremely rare in *Heteronyx* that I should not be surprised if the species is wrongly attributed to this genus.

Group II.

The known species attributable to this group are even less in number than those of Group I., and they are quite as rare in collections. They seem to fall naturally into a common aggregate with the exception of *H. fortis*, Blackb., ***subfortis***, Blackb., and ***lilliputanus***, Blackb., the robust subquadrate form and glabrous (or nearly so) subopaque dorsal surface of the former two giving them a somewhat aberrant appearance, and the last named by its diminutive size and other characters having a facies not in the least suggestive of a place among the other species of this group. I regret having

to record here an error in the description of *H. insignis* (Proc. Linn. Soc., N.S.W., 1888, p. 1332), by which its antennæ were said to be 8-jointed, and that (with its other characters) would place it in this group. Its antennæ have 9 joints, and I can account for the mistake only by supposing that after I had examined the antennæ I intended to place it among those with 9-jointed antennæ awaiting description, but by some oversight placed it among those with only 8 joints in their antennæ. It is a member of Group IV.

The following is a tabular statement of some of the distinctive characters of the *Heteronyces* of this group: —

A. Hind angles of prothorax (viewed from above) quite defined (size moderate, 3 l. or more).
  B. Elytra having an apical row of granules bearing stout bristles ... tristis, *Blackb.*
  BB. Apex of elytra not as B.
    C. Clypeus and frons present a continuous surface.
      D. Head and pronotum uniformly confluently and asperately punctulate ... ... torvus, *Blackb.*
      DD. Pronotum smoothly and not closely punctulate ... ... hispidulus, *Blackb.*
    CC. Clypeus on a plane quite different from that of frons.
      D. Elytra non-striate and uppermost tooth on front tibiæ obsolete ... ... brevicollis, *Blackb.*
      DD. Species not combining the two characters of D.
        E. Apical part of elytra deplanate in front of its membranous border.
          F. Front face of labrum distinctly wider than its distance from summit of clypeus ... ... frontalis, *Blackb.*
          FF. Front face of labrum distinctly narrower than its distance from summit of clypeus ... ... nitidus, *Blackb.*
        EE. Elytra not deplanate in its apical part.
          F. Elytra distinctly substriate.
            G. Elytral puncturation rugulose ... ... fortis, *Blackb.*
            GG. Elytral puncturation smooth ... ... subfortis, *Blackb.*
          FF. Elytra non-striate (the subsutural stria of course excepted) ... ... spretus, *Blackb.*
AA. Hind angles of prothorax entirely rounded off (size very small, less than 2 l.) ... ... lilliputanus, *Blackb.*

H. hispidulus, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; piceus, antennis palpisque rufis; pilis brevibus fulvis minus dense (et supra capillis elongatis erectis nonnullis) vestitus; clypeo confertim ruguloso, antice late rotundato vix sinuato, labro summo clypei planum haud attingenti; fronte crebre sat grosse rugulosa; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 22 ad 13 latiori, antice sat fortiter angustato, supra sparsius sat fortiter punctulato (puncturis circiter 15 in segmenti longitudine), lateribus pone mediam partem sat fortiter rotundatis, angulis anticis acutis sat productis posticis (superne visis) leviter obtusis, basi leviter bisinuata, margine basali ad latera magis elevato; elytris granulatis, squamose nec crebre punctulatis (trans elytron puncturis circiter 20); pygidio puncturis (his capillas erectas ferentibus) sparsis impresso; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus fortiter tridentatis: tarsorum posticorum articulo basali quam 2us sat breviori quam 3us nonnihil longiori; unguiculis appendiculatis. Long., 5¼ l.; lat., $2\frac{3}{4}$ (vix.).

This species is easily identified by the characters indicated in the tabulation.

Western Australia; Coolgardie.

H. subfortis, sp. nov. Minus elongatus, robustus, postice parum dilatatus; minus nitidus; piceus, pedibus rufescentibus, antennis palpisque testaceis; supra sat glaber; clypeo confertim subtilius ruguloso, antice late nec sinuatim rotundato; labro summo clypei planum nullo modo attingenti; fronte crebre subtilius punctulata; fronte clypeoque ut plana valde disparia visis, sutura clypeali subcarinata; antennis 8-articulatis; prothorace quam longiori ut 7 ad 4 latiori, antice sat fortiter angustato, supra subtiliter vix crebre punctulato (puncturis circiter 21 in segmenti longitudine), lateribus sat arcuatis, angulis anticis acutis sat productis posticis (superne visis) sat acute rectis retrorsum leviter directis, basi fortiter bisinuata, margine basali sat æqualiter elevato; elytris concinne sat crebre subtilius nec rugulose punctulatis (trans elytron puncturis circiter 25), striis circiter 4 obsolete impressis; pygidio crebrius subtilius punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus; tibiarum anticarum dentibus inferioribus 2 obtusis sat magnis, altera fere carenti; tarsorum posticorum articulo basali quam

2us parum breviori, quam 3us parum longiori: unguiculis appendiculatis. Long., $4\frac{1}{5}$ l.; lat., $2\frac{1}{5}$ l.

This species is a near ally of *H. fortis*, Blackb., differing from it widely, however, by its less opaque surface and by the uppermost external tooth of the front tibiæ scarcely indicated and the surface of its elytra without any rugulosity; in *fortis* the uppermost tooth being acute and quite normally defined and the surface of the elytra quite strongly, though not coarsely, rugulose. Other distinctions will be found by comparing the descriptions of the species. The present insect probably varies in colour.

New South Wales; Mulwala (given to me by Mr. Sloane).

LONGICORNES.

Demonassa.

D. capitalis, sp. nov. Elongata; picea, pube ferruginea et alba variegata; illa in capite ad latera et circum oculos, in pronoto maculatim, in elytris basin versus et maculatim pone medium, et in sternis abdomineque maculatim disposita; hac in pronoto ad latera posita, in elytris fasciam latam antemedianam et pone medium maculas multas facienti, metasternum fere totum vestienti, in abdominis lateribus et in tarsis disposita; fronte inter oculos fere parallela vix manifeste punctulata; prothorace fere ut *D. dichotomi*, Newm. (*i.e.*, cristis 2 bifidis discoidalibus et tuberculis parvis multis instructo); elytris basin versus tuberculis multis instructis (e his tuberculo quam ceteri majore mox pone basin inter suturam humerumque mediano sat elevato), ante medium grosse sparsim punctulatis (puncturis inter pubem nigris apparentibus), mox pone medium subtilius punctulatis, in parte tertia apicali fere lævibus, ad apicem fortiter bispinosis, in parte postica dimidia costa lata obtusa longitudinali lævi instructis; antennis (exempli typici) quam corpus sat longioribus pube ferruginea et alba plus minusve vestitis, subtus ciliatis. Long., 12 l.; lat., 4 l.

Resembles *D. dichotoma*, Newm. Apart from the distinct colouring and pattern of its pubescence it differs from that species, *inter alia*, by its forehead nearly parallel-sided between the eyes, by the principal tubercle of the elytra being very much smaller and placed much closer to the base, by the puncturation of the front half of the elytra much coarser and less close, by the hind part of the elytra almost punctureless, and by the apex of its elytra strongly bispinose.

North Queensland (Cairns); sent by Mr. French.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1907-8.

———

ORDINARY MEETING, NOVEMBER 5, 1907.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

MOTION.—DR. ROGERS, M.A., proposed—"That the Government be asked to provide funds for the appointment of a Government Botanist, with the special object of obtaining an expert knowledge of the endemic vegetation of this State for economic purposes." Dr. Rogers pointed out that of the three great branches of natural science the Government of the State had only seriously promoted that of geology. Towards the elucidation of the native flora, except in the branch of forestry, it had provided no financial assistance. A careful study of the flora of the State might not only lead to the discovery of valuable fodder plants and medicinal agents, but sound botanical knowledge was essential to the thorough understanding of its geological problems. Not only was this State in the unfortunate position of having no public authority to supply botanical information to the community, but South Australians were in the invidious position of being unable to exchange scientific courtesies with botanists in other parts of the world. The motion was seconded by Mr. W. HOWCHIN, F.G.S., and carried.

NOMINATION.—Mr. William Pope, Solicitor, Adelaide.

EXHIBITS.—Mr. A. H. C. ZIETZ, F.L.S., Assistant Director of the S.A. Museum, exhibited a skin of a young black-eared cuckoo *(Misocalius palliolatus)*, which is fed by the red throat *(Sericornis brunnea)*, and a stem of *Hylacola cauta*, all from the neighbourhood of Meningie; also, three ground spiders, new to South Australia, from the same district. Mr. Zietz also exhibited a double-yolked swan's egg; a piece of shelly travertine, from a raised sea beach on the Coorong. At the time of Mr. Zietz's visit the Coorong was full of crabs; he also noticed gypsum on the samphire flats. Dr. ROGERS, M.A., showed sketches of several orchids in which the blossoms were white. Many orchids show this

albinism, amongst these several *Caladenias* and *Glossodia niger*. The President mentioned that the same colourless condition occurs amongst the mollusca. The President exhibited several shells; a very fine specimen of *Pleurotomaria proteus*, in which the deep slit in the outer margin was pointed out, and a *Murchisonia lloydi* and a *Turritella runcianata;* also, two blades of a pigmy whale *(Neobalacua marginata)*, from an animal found stranded on Thistle Island. Miss Bundey showed several Jamaica mats, made from the inner bark of the "lace-tree."

Ordinary Meeting, April 7, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—William Pope, Solicitor, as a Fellow.

By-law.—It was proposed by Mr. Howchin, and carried—"That by-law, section iv., paragraph 8, should in future read 'September 15,' instead of September 30, in every year."

Nominations.—J. P. V. Madsen, D.Sc., and W. Noel Benson, B.Sc., both of the University of Adelaide.

Exhibits.—Mr. J. G. O. Tepper, F.L.S., of the Museum, two cases of butterflies, from Queensland, partly from Mr. Bell's collection, and partly those presented to the Museum by Mr. Samuel Dixon. Mr. J. McC. Black exhibited an umbelliferous plant *(Apium leptophyllum*, North), found by Mr. Griffith at the Finniss, and a grass *(Isachne australis*, Brown) from Myponga. Dr. Pulleine exhibited a large spider *(Phlogius crassipes*, Koch), from Orroroo, found in the ground occupying cracks or other holes, the entrance of which it covers with webbing. This spider is said to whistle, but this characteristic has not been fully established.

Papers.—"New Australian Lepidoptera of the Families *Noctuidæ* and *Pyralidæ*," by A. Jefferis Turner, M.D.; "The Ionization remaining in Gases after removal from the Influence of the Ionizing Agent," by J. P. V. Madsen, D.Sc.; "An Experimental Investigation of the Nature of the Gamma Rays," by Professor W. H. Bragg, M.A., F.R.S., and J. P. V. Madsen, D.Sc. Dr. Madsen, by means of diagrams on the blackboard, showed how he had arrived at the conclusions set forth in his paper. Prof. Bragg explained at some length that his and Dr. Madsen's investigations of the gamma rays tended to show that these rays are material, and that the "Ether Pulse Theory" is no longer tenable. Prof. Rennie, D.Sc., drew the attention of the meeting to the important nature of the work that

was being carried on by Prof. Bragg, and which would probably revolutionize many of the scientific ideas of to-day.

ORDINARY MEETING, MAY 5, 1908.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

BALLOT.—J. P. V. Madsen, D.Sc., B.E., Lecturer at the University of Adelaide, and W. Noel Benson, B.Sc., Lecturer at the University of Adelaide, were elected Fellows.

THE PRESIDENT laid on the table a letter from Mr. Dodwell, of the Commonwealth Meteorological Department, inviting Fellows and members to the Observatory to inspect the seismograph which was being installed there.

EXHIBITS.—Mr. J. G. O. TEPPER, F.L.S., laid on the table a bound volume of "Separata" of descriptions of new Australian plants not contained in Bentham's "Flora Australiensis," by the late Baron Ferdinand von Mueller. Mr. TEPPER also exhibited a trombone, showing the work of larvæ of *Aulacophora hilaris* (Boisd.), a small beetle of the Family *Chrysomelidæ*. A leaf covered with web of *Stenopsocus stigmaticus*, a species of the Family *Psosidæ (Copeognathidæ)*, which infests many trees and plants without seemingly being injurious. The mature insect is 1-20th of an inch across open wings, belonging to the same Family as the wingless and spring-tails, the latter found in pools after rain. Male and female galls of *Brachyscelis ovicoloides*, a genus of Coccidæ. Dr. PULLEINE exhibited a trap-door spider of very unusual appearance, possibly a new species. From a sketch on the blackboard Dr. Pulleine showed the peculiar shape of the cephalothorax and the position of its eight eyes.

PAPERS.—"Notes on the Geology of the Mount Lofty Ranges, chiefly the portion East of the Onkaparinga River," by W. G. WOOLNOUGH, D.Sc., F.G.S., University of Sydney; "An Experimental Investigation of the Nature of the Gamma Rays," part ii., by Prof. W. H. BRAGG, M.A., F.R.S., and J. P. V. MADSEN, D.Sc. In the discussion which followed the reading of Dr. Woolnough's paper, Mr. HOWCHIN stated that he could not agree with the author's generalization on the geology of the Mount Lofty Ranges, and particularly in relation to the geological section which Dr. Woolnough had made from Mount Lofty to the River Murray. The section showed the Mount Lofty Ranges to consist of a monoclinal series of beds, the older members being on the west and the newer on the east. No such regular succession of beds existed, as the series was broken by the exposure of an important pre-Cambrian axis, from which the beds dipped west

and east,' causing a repetition of the respective beds on each side of the geological axis.

ORDINARY MEETING, JUNE 2, 1908.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

NOMINATION.—W. G. Woolnough, D.Sc., F.G.S., of Sydney University, as a Corresponding Member.

NEW BY-LAWS.—A sub-committee appointed by the Council on April 25, 1908, to consider the way in which the Society's finances should be managed, recommended that the following By-laws be added to those already adopted:—

Section V.—Finance—

(1) All investments made by the Society in stock or other securities shall be in the name of "The Royal Society of South Australia (Incorporated)," and no dealings in or transfers of the same shall be made except under the seal of the Society.

(2) The receipt of the Treasurer shall be a sufficient receipt for all interest or other revenue accruing from such investments.

(3) All subscriptions and other moneys received by the Treasurer shall be deposited in the name of "The Royal Society of South Australia (Incorporated)," in such Bank or Banks as the Council may from time to time determine, and all cheques drawn upon such Bank or Banks shall be signed by the Secretary and Treasurer.

(4) The Treasurer shall prepare annually a statement of receipts and expenditure, and a Balance-sheet, which shall be submitted to the Auditors for audit prior to the Annual Meeting of the Society. (Signed) WALTER RUTT, Convener; W. H. SELWAY. May 15, 1908.

Proposed by Prof. RENNIE, D.Sc., seconded by Mr. SAMUEL DIXON—"That the meeting accept and confirm the By-laws as recommended by the sub-committee." Passed.

EXHIBITS.—Mr. W. HOWCHIN, F.G.S., exhibited some specimens from the quarries near Aldgate Railway Station, which have an important bearing on the age of the Mount Lofty beds. Mr. Howchin has already published his geological observations on this locality, maintaining that at Aldgate and elsewhere the Cambrian grits, etc., rest unconformably on an older pre-Cambrian floor. The exhibits presented at the meeting, Mr. Howchin stated, demonstrated that view to

be correct. Aldgate Creek (near the Pound) runs over a coarse variety of granite known as pegmatite, forming a part of the pre-Cambrian complex. In a recent visit to the Aldgate quarries Mr. Howchin discovered, in one of these, a band of coarse angular fragments of pegmatite interbedded with ordinary felspathic grits of the neighbourhood. This proves that the pegmatites from which this band of broken fragments was derived formed the hard rocks of the shore line when the Cambrian deposits were in process of formation, thus establishing a geological uncomformity of great interest. Mr. J. G. O. Tepper, F.L.S., exhibited a black beetle (*Blatta*) found in the pipeclay some distance below the surface at Teatree Gully, the upper portion of a nest of a trap-door spider, with circular lid, and also the fruit of the Yucca, which Mr. Tepper informed the meeting requires the agency of an unknown moth to mature. Mr. Tepper further exhibited a specimen of "knotted" schist, from the neighbourhood of Lyndoch, Hundred of Barossa. The bed from which the specimen was obtained is usually bounded by quartzite on one side and mica or gneissic schist on the other, and exhibits a general north-easterly strike. It is seen in Section 511, on the western side of the Barossa Creek, and passes north through Sections 509 and 510. A hornblende schist makes a small outcrop at the north-west angle of Section 3,146 and in Section 3,141.

Paper.—"Notes on South Australian Marine Mollusca, with Descriptions of New Species," Part viii., by J. C. Verco, M.D., F.R.C.S.

Ordinary Meeting, July 7, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—W. G. Woolnough, D.Sc., lecturer at the University of Sydney, was elected a Corresponding Member.

Endowment and Research Fund.—Mr. W. Howchin, F.G.S., proposed a vote of thanks to the President, Dr. Verco, for his generous gift of £1,000, and also to Mr. Thomas Scarfe, the other generous donor to this fund. Prof. R. W. Chapman, M.A., B.C.E., in supporting the motion, said that in a new country research work, such as this Society is doing, needed encouragement and support. The hon. treasurer, Mr. W. Rutt, C.E., reminded the members that an anonymous gift of 10s. had been made to the fund, and suggested that that donor should be included in the motion. Carried.

Exhibits.—Mr. Ashby showed a singing toad from

Western Australia *(Bufo occidentales musicales)*, the skin of a new species of little green pigeon, from Port Keats, N.T. *(Chalcophaps occidentales*, North), and a fine specimen of *Voluta Bednalli*, from the same district. Also a puff-ball from Blackwood, which when bursting takes the form of a globose network. Dr. PULLEINE exhibited five stone axes from Queensland, one of which, the largest, was from the Leichhardt Ranges. These axes are generally found when clearing the forest lands. Mr. W. HOWCHIN, F.G.S., remarking on these, said that the rock selected by the natives is a basic igneous rock, chosen on account of its hardness and toughness, and was probably used in barter between tribes. It was also stated at the meeting that a quarry originally worked by the natives had been discovered in Gippsland.

Mr. W. HOWCHIN, F.G.S., read the discussion which took place at a meeting of the Geological Society of London upon the occasion when his paper on Glacial Beds of Cambrian Age in South Australia, was read.

PAPERS.—"Notes on Some Species of the Isopod Family *Sphæromidæ* from South Australia," by W. H. BAKER, F.L.S. "Secondary Gamma Rays," by J. P. V. MADSEN, D.Sc., B.E.

ORDINARY MEETING, AUGUST 4, 1908.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

BALLOT.—Mr. Howard Whitbread was elected to act as Auditor during Mr. Smeaton's illness.

EXHIBITS.—Mr. W. HOWCHIN, F.G.S., exhibited (by the courtesy of Mr. J. W. Jones) a portion of the core of a bore on Mr. Ind's property, near Paradise Bridge. The specimen, obtained at 160 ft., was a good example of glauconite, or green earth (a hydrous silicate of iron, alumina, and potash). Geologically it represents the lowest member of the Eocene beds in South Australia, and is found at the base of the series at Aldinga and in the Kent Town bore. Its occurrence in the neighbourhood of Paradise shows that the sea in Lower Tertiary times extended to what is now practically the base of the hills. Glauconite is forming at the present day in the deep seas at a depth from about 100 to 1,000 fathoms, and is often found deposited in the shells of the foraminifera; the shells weather away, and the glauconite grains have the form of internal casts of the shells. Mr. A. G. EDQUIST exhibited two examples of *Lepidurus*—fresh-water crustaceans. They are found only in rainwater pools that dry up. The eggs undergo a process of desiccation before they will incubate.

The animal breathes with its feet, which are kept in constant motion, thus helping it to swim.

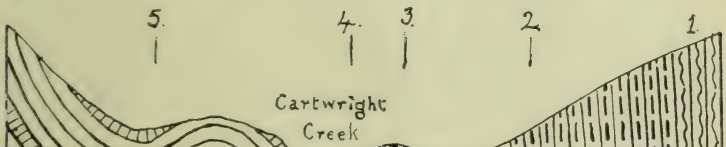
Papers.—"Secondary Röntgen Rays," by Prof. W. H. Bragg, M.A., F.R.S. "Description of Australian Curculionidæ, with Notes on Previously-described Species, Part vi. Sub-family *Leptopsides*," by A. M. Lea, Government Entomologist, Tasmania. "New Australian Lepidoptera," No. 25, by Oswald B. Lower, F.E.S., Lond.

Ordinary Meeting, September 8, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Exhibits.—Mr. W. N. Benson, B.Sc., exhibited Cambrian Glacial Till, from Cartwright Creek, twenty-seven miles N.N.W. of Broken Hill. [The following particulars bearing on this exhibit were supplied by Mr. Benson.]

The following series occurs dipping to N.E.:—1. Knotted mica-schist. 2. Mica-schist with angular included fragments of schist and quartzite and boulders of quartzite, quartz, and granite. Estimated thickness, about 300 yards. 3. Band of limestone, up to 20 ft. in width, and pinching out occasionally. 4. Band about 60 ft. thick, of large boulders, up to 4 ft. in diameter, of granite, quartzite, and schist, in a schistose or gritty matrix. 5. Knotted mica-schist with interbedded quartzite bands.



The correlation of the series 2, 3, and 4 (described by Mr. J. B. Jaquet in 1893 as schistose conglomerate), with lower Cambrian glacial beds of South Australia, is based on —(a) Their lithological character; (b) nature and mode of occurrence of the interbedded limestone; (c) thickness of the series. Data are not yet sufficient for correlation on stratigraphical grounds. What little is known is confirmatory. The importance of their determination as glacial beds is:—

(1.) It determines the age of the Barrier Range crystalline schists, and fixes an horizon in them which may be correlated with a portion of the Mount Lofty Lower Cambrian series.

(2.) It shows the identity of the Barrier Range crystalline schists with the slates and slaty conglomerates of the same area among which Mr. Mawson has proved that the glacial beds occur.

(3.) It shows the identity of the plane of schistosity and bedding-plane in Cartwright Creek.

New South Wales is unique among the Australian colonies, so far as is at present known, in possessing distinct evidence of the three great ice ages—Cambrian, Permo-carboniferous, and Pleistocene.

Papers.—"Synopsis of the Fishes of South Australia," Part i., by A. H. C. Zietz, F.L.S., C.M.Z.S. "Description of a Hitherto Undescribed Species of Shark from Investigator Strait," by the same author. "A Contribution to the Botany of South Australia," by J. H. Maiden, Hon. Secretary of the Royal Society of New South Wales.

Annual Meeting, October 6, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

The Annual Report and Balance-sheet were read and adopted.

Election of Officers and Members of Council.—J. C. Verco, M.D., F.R.C.S., proposed by Prof. W. H. Bragg and seconded by Mr. W. Howchin, was unanimously elected President; Vice-Presidents, Prof. E. H. Rennie, D.Sc., and Rev. Thos. Blackburn, B.A.; Hon. Treasurer, W. Rutt, C.E.; Retiring Members, W. Howchin, F.G.S., and W. B. Poole, were re-elected.

Exhibits.—Mr. A. H. C. Zietz, F.L.S., C.M.Z.S., showed a number of fishes to illustrate his paper.

Papers.—"Notes on South Australian Marine Mollusca, with Descriptions of New Species," Part ix., by J. C. Verco, M.D. "The Strength of South Australian Timbers," by Prof. R. W. Chapman, M.A., B.C.E. "Descriptions of New Australian *Hesperiadæ*," by Oswald B. Lower, F.E.S., Lond.; "Australian *Tortricina*," by the same author. "Addendum to Prof. W. H. Bragg's Preliminary Note on the Secondary Röntgen Rays," by Prof. W. H. Bragg, M.A., F.R.S. "Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species," No. xxxviii., by Rev. Thos. Blackburn, B.A. "Synopsis of South Australian Fishes," Part ii., by A. H. C. Zietz, F.L.S., C.M.Z.S.

ANNUAL REPORT, 1907-8.

The Council has the pleasure to report that during the year the work of the Society has included some important papers by Prof. Bragg and Dr. Madsen, of the University of Adelaide, recording their investigations of the nature and forms of electric radiations. Both these gentlemen are soon to leave this State—Professor Bragg to undertake research work at the University of Leeds, England, while Dr. Madsen returns to his "Alma Mater," the University of Sydney. The Council regrets the loss to the Society of two such valued members, but wishes them success and advancement each in his particular work.

Papers have been received from Dr. Verco in continuation of his classification and descriptions of the Marine Mollusca of South Australia, and from Dr. W. G. Woolnough, of the University of Sydney, on the still debatable geological formations of the Mount Lofty Ranges. Mr. Zietz has given a synopsis of the Fishes of South Australia, and Mr. W. H. Baker has contributed further descriptions of the Crustacea of the same Province, while the Rev. Mr. Blackburn and Mr. A. M. Lea have each continued his classification and descriptions of the Coleoptera, and Dr. Jefferis A. Turner and Mr. Oswald B. Lower of the Lepidoptera.

Many curious and interesting specimens in natural history have been exhibited by members during the year.

As a necessary corollary to this varied work the publications of the Society are increasingly in demand for exchange with learned Societies in all parts of the world. The list of exchanges now includes the names of 184 Societies; of these eighty-four are European and forty American. It is intended, as soon as shelving accommodation is provided for the Library, to bind the publications of these Societies as rapidly as means will permit. In the meantime the Council has regretfully to state that the Library, which every year is becoming increasingly valuable, is still in a chaotic condition, owing to the want of these shelves.

The Clarke Memorial Medal has been awarded to Mr. W. Howchin, F.G.S., by the Royal Society of New South Wales, in recognition of his long-continued scientific labours, and more particularly on account of his important discoveries of evidences of a great ice age in earlier [lower] Cambrian times in Australia, and also for his original work on extinct forms of Foraminifera.

Endowment and Research Fund.—This fund has received generous recognition at the hands of our President (Dr. Verco) and of Mr. Thomas Scarfe, who have each given

£1,000 for the purposes for which this fund is intended. This money has been invested in the inscribed stock of the State. A previous initial sum of 10s. had been received from an anonymous donor.

Membership.—Hon. Fellows, 9; Corresponding Members, 6; Fellows, 70; Associate, 1.

Obituary.—Thomas Drury Smeaton, member from 1857. Professor Rennie says of Mr. Smeaton, who was born within the sound of Bow Bells: "In early life he was articled to a London engineer. After finishing his course he came to Adelaide under engagement to the South Australian Company. On his arrival in 1853, there being no opening for him as an engineer, he was taken into the service of the Company's financial institution—the Bank of South Australia. Mr. Smeaton remained in the Bank till 1884, having at various times filled the position of Inspector, Assistant Manager, and Manager. On his retirement he settled at Blakiston, and in 1905 removed to Mount Lofty. He spent most of his leisure in literary and scientific pursuits. His reading was comprehensive, and he was a keen and close observer. There were few scientific subjects with which he was not more or less acquainted. He was a mathematical genius, and had an accurate knowledge of experimental optics and acoustics. He devoted a considerable portion of his time to the study of botany and of certain parts of zoology, and acquired a fine collection of South Australian Hydrozoa and Polyzoa. A country walk with him was a delightful experience, so keen was he to see all there was to be seen, and so willing to impart to others the information he had gained by his own close observation. He early joined the Adelaide Philosophical Society, which was affiliated with the Public Library, and which was the forerunner of the Royal Society of South Australia. Mr. Smeaton was the author of many interesting papers, and few subjects seemed out of his reach. Among other papers he contributed one on the Rainbow, published in an early issue of 'Nature.' He was a member of the Adelaide Hospital Board for some years, and was one of the originators of the Good Samaritan Fund, the honorary secretarial duties of which he discharged for a long period. Mr. Smeaton possessed a keen sense of humour, and was a charming companion. He died at Mount Lofty on February 18, 1908, at the age of seventy-six years. His loss is greatly felt by those who during his life were fortunate enough to be included amongst his friends."

Adopted, Annual Meeting, October 6, 1908.

Jos. C. Verco, *President.*
G. G. Mayo, *Hon. Sec.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

REVENUE AND EXPENDITURE FOR 1907-8.

Dr.	£	s.	d.	£	s.	d.
October 1, 1907.						
To Balance				317	16	4
,, Subscriptions—						
Royal Society	66	8	3			
Field Naturalists' Section ...	20	16	6			
Microscopical Section	6	5	0			
Malacological Section ...	2	7	6			
				95	17	3
,, Grants from Government						
On Subscriptions	83	8	0			
For Printing Reports on Scientific Investigations in South Australia	150	0	0			
				233	8	0
,, Sale of "Transactions"				1	15	3
,, Interest on S.A. Government Stock	25	1	4			
,, Savings Bank	7	12	5			
				32	13	9
				£681	10	7

Cr.	£	s.	d.	£	s.	d.
By "Transactions"—						
Printing	92	15	6			
Illustrating	24	18	0			
Publishing	9	10	7			
				127	4	1
,, Grants—						
Field Naturalists' Section ...	14	0	0			
Microscopical Section ...	6	0	0			
Malacological Section ...	1	0	0			
Epidiascope Committee ...	15	15	0			
				36	15	0
,, Library—						
Cataloguing, etc.	5	6	3			
Carriage of Books	0	6	9			
				5	13	0
,, Caretaking and Lighting ...				8	2	6
,, Printing, Postage, and Stationery				10	8	6
,, Advertising				3	2	3
,, Exchange on Cheques ...				0	3	0
,, Furniture				2	1	6
,, Transfer of Stock				0	5	0
,, Transferred to Endowment Fund				0	10	0
,, Balance, September 30, 1908				487	5	9
				£681	10	7

Examined and found correct,

HOWARD WHITBREAD. } Auditors.
J. S. LLOYD, F.I.A.S.A. }

WALTER RUTT, Treasurer.

ENDOWMENT FUND.

Dr.	£	s.	d.
To Transferred from General Account	0	10	0
,, Donation from Mr. Scarfe	1,000	0	0
,, Donation from Dr. J. C. Verco, S.A. 3¾ per cent. Inscribed Stock (at par)	1,000	0	0
	£2,000	10	0

Cr.	£	s.	d	£	s.	d.
By £2,000 S.A. 3¾ per cent. Inscribed Stock (at par). Certificates in custody of Secretary	2,000	0	0			
Less Commission returned ...	2	10	0			
				1,997	10	0
,, Balance				3	0	0
				£2,000	10	0

SUMMARY OF BALANCES.

	£	s.	d.
Revenue and Expenditure Account	487	5	9
Endowment Fund	3	0	0
	£490	5	9

	£	s.	d.
In Savings Bank	257	12	5
,, Bank of Australasia	232	13	4
	£490	5	9

Examined and found correct,
HOWARD WHITBREAD,
J. S. LLOYD, F.I.A.S.A. } Auditors.

WALTER RUTT, Treasurer.

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FOR YEAR 1907-8.

TRANSACTIONS, JOURNALS, REPORTS, ETC.

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AUSTRIA AND GERMANY.

Basle—Naturforschende Gesellschaft zu Basel, Neue Capillar- und Capillaranalytische Untersuchungen, Band xix., Heft 2.

Berlin—Königl. Preuss. Meteor. Instituts Veröffentlichungen der Ergebnisse der Beobachtungen an den Stationen, 1904; Ordnung i., ii., 1902; Ordnung ii., iii., 1906. Veröffentlichungen der Ergebnisse der Niederschlagsbeobachtungen, No. 197, Jahr 1905. Ergebnisse der Gewitterbeobachtungen, No. 195, Jahre 1903-5. Berichte für 1907.

——— Königl. Preuss. Akademic der Wissenschaften zu Berlin, Sitzungsberichte, 1907, Nos. 39-53; 1908, Nos. 1-23.

——— Deutsches Meteorologisches Jahrbuch, Heft 1, 1906.

——— Gesellschaft für Erdkunde, Zeitschrift der, 1907, Nos. 7-10; 1908, Nos. 2-6.

——— Berliner Gesellschaft für Anthrop., Ethnol., und Urgeschichte. Ergänzungsblätter zur Zeitschrift für Ethnologie, Jahrgang 39, Heft 4, 5, 6, 1907; Jahrgang 40, Heft 1-4, 1908.

Breslau—Aus der Zeitschrift für Ethnologie, by H. Basedow, 1907, Heft 4, 5; 1908, Heft 2.

Freiburg—Naturforschenden Gesellschaft zu Freiburg, Berichte der, Band xv.

Göttingen—Königl. Gesellschaft der Wissenschaften zu Göttingen, Math. Phys. Klasse, Nachrichten von der, 1907, Heft 4, 5; 1908, Heft 1, 2. Geschäftliche Mitteilungen, 1906, Heft 2; 1907, Heft 2; 1908, Heft 1.

Hamburg—Mitteilungen aus dem Naturhistorischen Museum, Jahrgang xxiv., 1906.

——————— Verhandlungen des Naturwissenschaftlichen Vereins, 1906, Dritte Folge xiv.; 1907, Dritte Folge xv.

——————— Abhandlungen aus dem Gebiete der Naturwissenschaften, herausgegeben vom Naturwissen. Verein in Hamburg, Band xix., Heft 1, 2.

Heidelberg—Berichte über Land- und Forstwirtschaft in Deutsch Ostafrika, Band iii., Heft 4.

Leipzig—Städtischen Museums für Völkerkunde, Veröffentlichungen des, Heft 1, 2. Jahrbuch, Band i., 1906.

München—K. B. Akademie der Wissenschaften zu München, Math. Phys. Klasse, Sitzungsberichte der, 1907, Heft 3; Abhandlungen, Band xxiii., zweite Abteil; Band xxiv., erste Abteil.

Nürnberg—Naturhistorischen Gesellschaft zu Nürnberg, Abhandlungen der, Band xvi. Jahresbericht, 1905.

Trencsen—Jahresheft des Naturwissenschaftlichen Vereins des Trencsener Comitates, 1906-7.

Vienna—Kaiserliche Akademie der Wissenschaften in Wien, Sitzung. der Math., Naturwiss., Jahrgang 44, Nos. 1-27, 1907.

——— Verhandlungen der Oestreichischen Kommission für die Internationale Erdmessung, Dec., 1906; March, 1907.

——— Annalen des K. K. Naturhistorischen Hofmuseums, Band xxi., Nos. 2-4.

——— Verhandlungen der K. K. Geologischen Reichsanstalt, Jahrgang 1907, Nos. 11-18; 1908, Nos. 1-6.

——— K. K. Zoologische-Botanische Gesellschaft in Wien, Jahrgang 1907, Band lvii., Heft 6-10; Jahrgang 1908, Band lviii., Heft 1-5.

Australia and New Zealand.

Adelaide—Public Library, Museum, and Art Gallery, Annual Report, 1906-7.

——— School of Mines and Industries, Annual Report, 1906; Prospectus for 1908.

——— Catalogue of Minerals in the Technological Museum of the South Australian School of Mines and Industries, compiled by H. Basedow, 1907.

——— Department of Mines, Review for year ended June 30, 1907. Short Review for half-year to December 31, 1907; June 30, 1908.

——— The Mines of South Australia, A Record, Fourth Edition, February, 1908.

——— Woods and Forests Department, Annual Progress Report, 1906-7.

——— Adelaide Observatory, Meteorological Observations for 1905.

——— Adelaide Chamber of Commerce, Annual Report, the 57th, 1907.

Adelaide—Northern Territory of South Australia, North and Eastern Coasts, Report by Government Geologist, 1907.
Brisbane—Queensland Department of Mines, Geological Survey, Publications, Nos. 204, 214, 216.
——— Queensland Flora, Extracts, vol. xix., part 5; vol. xx., parts 2, 4, 5; vol. xxi., part 1.
——— Royal Society of Queensland, Proceedings, vol. xx.
——— Queensland Museum, Annals, No. 8.
——— The Queensland Naturalist, vol. i., No. 1.
Melbourne—Victoria Department of Agriculture, Journal, vol. v., parts 10-12; Index to vol. v., vol. vi.; parts 1-9. Report for 1905-7.
——— Department of Mines, Geological Survey Records, vol. ii., parts 2-4. Memoirs 1908, No. 6.
——— Mines and Water Supply, Annual Report, 1907.
——— Victorian Yearbook, 1906-7. Three copies.
——— Australasian Institute of Mining Engineers, vol. xii., 1907.
——— Royal Society of Victoria, Proceedings, vol. xx. (New Series), parts 1, 2; vol. xxi. (New Series), part 1.
——— Victorian Geographical Journal, vol. xxv., 1907.
——— National Museum, Memoirs, No. 2.
——— The Victorian Naturalist, vol. xxiv., Nos. 7-12; vol. xxv., Nos. 1-5.
——— Society of Chemical Industry of Victoria, vol. viii., Nos. 1, 2.
——— The Australian Commonwealth—Its Resources and Productions, 1908.
——— Meteorology of Australia, Commonwealth Bureau of Meteorology, Bulletin, Nos. 1, 2.
——— Official Yearbook of the Commonwealth of Australia, No. 1, 1901-7.
Launceston—The Progress of the Mineral Industry of Tasmania, Quarterly Reports, September, 1907; December, 1907; March, 1908; June, 1908.
——— The Department of Mines, Geological Survey Bulletin, Nos. 1-3.
Perth—Meteorological Observations, 1906.
——— Department of Mines, Report, 1907.
——— Western Australian Natural History Society Journal, No. 4.
——— Geological Survey Bulletin, Nos. 27-30.

Perth—Government Gazette, Supplement, 1907, Nos. 62, 66; 1908, Nos. 3, 7, 12, 20, 25, 32, 36, 39.

Sydney—Department of Mines, Annual Report, 1907. Geological Survey. Problems of the Artesian Water Supply of Australia, October, 1907.

——— Department of Mines and Agriculture, vol. xviii., parts 10-12, vol. xix., parts 1-9. Miscellaneous Publications, 1899, No. 313. 1894, Paddy's Lucerne. Geological Survey, Memoirs, Nos. 4 and 6 and Maps. Palæonotology, Memoirs, Nos. 10, 13, part 2. Mineral Resources, No. 12.

——— Royal Society of New South Wales, Reprints, vol. xxxvii., July, 1903.

——— Linnean Society of New South Wales, Proceedings, vol. xxxii., parts 3, 4; Nos. 127, 128. Vol. xxxiii., parts 1, 2; Nos. 129, 130.

——— Linnean Society of New South Wales, From the Proceedings, The Flora of Norfolk Island, part 1. Abstract of Proceedings, September-November, 1907; March to July, 1908.

——— Australian Museum, Report the 53rd, June, 1907; Records, vol. vi., No. 6; vol. vii., Nos. 1, 2.

——— Public Library, Report of Trustees, 1907.

——— Botanic Gardens and Domains, Report, 1906.

——— New South Wales Naturalists' Club, Journal and Magazine, vol. i., part 11.

——— Fisheries of New South Wales, Annual Report of Commissioners, 1907.

——— Department of Fisheries, Additions to the Fish Fauna, No. 1. Note on Small Collection of Fishes from Sowarow Island. Preliminary Note on The Wafer. The Edible Fishes of New South Wales, 1908.

——— The Forest Flora of New South Wales, vol. iii., parts 7-10, vol. iv., part 1.

——— University Calendar, 1908.

——— Royal Anthropological Society of Australia, Journal, vol. ix., No. 10; vol. x., Nos. 1, 3, 4.

Auckland—Auckland Institute and Museum, Annual Report, 1907-8.

Wellington—New Zealand Institute, Transactions, vol. xxxix., 1906.

———— New Zealand Geological Survey, Bulletin, New Series, Nos. 4, 5.

Wellington—Mines Department, Dominion Laboratory, Annual Reports, the 40th and 41st. Report made at International Exhibition, Christchurch. Analyses of New Zealand Coals, 1906-7.

——————— Colonial Museum, Bulletin, No. 2.

——————— The Lesson of Evolution, by Frederick Wollaston Hutton, F.R.S.

BELGIUM AND HOLLAND.

Brussels—Société Entomologique de Belgique, Annales de la, tome li., 1907.

——————— Société Royale de Botanique de Belgique, Bulletin, tome xliii., fasc. 1-4.

——————— Société Royale Zoologique Malacologique de Belgique, Annales de la, 1906, tome xli.; 1907, tome xlii.

——————— Congrès International pour l'étude des Régions Polaires, Rapport d'ensemble, September, 1906, part 1.

——————— La Seconde Expedition Antarctique Belge, par Henryk Arctowski, Extrait du Bulletin de la Société Belge d'Astronomie. Nos. 11, 12, 1907.

——————— Commission Polaire Internationale, Procès Verbaux des Séances, 1908.

——————— Observatoire Royal de Belgique, Annuaire Astronomique, 1908.

——————— L'Observatoire Royal de Belgique, Annales de, tome iii., fasc. 3; tome x.; tome xi., fasc. 1.

Haarlem—Archives du Musée Teyler, Series 2, vol. xi., part 1.

Liège—Société Royale des Sciences, Mémoires, Series 3, tome vii.

Batavia—Koninkligke Natuurkundige Vereeniging, deel lxvii.

CANADA.

Halifax—Nova Scotian Institute of Sciences, Proceedings and Transactions, vol. xi., part 2, 1903-4.

Ottawa—Department of the Interior, Geological Survey, Annual Report, Palæontology, etc., vol. xvi. and Maps, 1904. General Index to Reports 1855-1906. Sheets of Maps. Reports, Nos. 958, 968. Summary Report, 1907, Nos. 949, 953, 977, 971, and Maps. Annual Report on Mineral Industries, Nos. 959, 979, 988, 992. The Falls of Niagara, 1905-6.

DENMARK.

Copenhagen—Geografisk Tidskrift, 19de Bind, 1907-1908, Hefte 4-6.

ENGLAND, IRELAND, AND SCOTLAND.

London—Conchological Society, Journal, vol. xii., Nos. 4-7.
——— Entomological Society, Transactions, 1907.
——— Royal Colonial Institute, vol. xxxix., 1907-8.
——— Linnean Society of London, Proceedings, Session 119th, November, 1906-June, 1907. List of Members, 1907-8.
——— Royal Society of London, Yearbook, 1908. Proceedings, Mathematical and Physical Sciences, Series A, vol. lxxix., Nos. A533, 534; vol. lxxx., Nos. A535-543; vol. lxxxi., Nos. A544-546. Biological Sciences, Series B, vol. lxxix., Nos. B534, 535; vol. lxxx., Nos. B536-541.
——— Royal Microscropical Society of London, Journal, 1907, parts 5, 6; 1908, parts 1-4.
——— The British Museum, General Guidebook. Eight Guidebooks. List of British Plants and Ferns. Catalogue of Lepidoptera, vol. vi. and Plates. Monograph on the Culicidæ, vol. iv.
——— National Physical Laboratory, Report, 1907.
——— Royal Gardens, Kew, Bulletin, 1907.
——— The State Correspondent, etc., vol. xiii., Nos. 9-12; vol. xiv., Nos. 2-8.
——— The Periodical, 1907, Nos. 41-46.
——— Electrical Engineering, vol. xi., No. 13.
Liverpool—Biological Society, Proceedings and Transactions, vol. xxi., 1906-1907.
Manchester—Literary and Philosophical Society, Memoirs and Proceedings, vol. lii., parts 1, 2.
Cambridge—Philosophical Society, Proceedings, vol. xiv., parts 3-5. List of Fellows, etc.
——— University Library, Report of the Library Syndicate, 1907.
Belfast—Natural History and Philosophical Society, Proceedings, 1906-1907.
Dublin—Royal Dublin Society, Economic Proceedings, vol. i., Nos. 11, 12. Scientific Proceedings, vol. xi., Nos. 13-28. Scientific Transactions, vol. ix., No. 6.
——— Royal Irish Academy, Proceedings, vol. xxvii., Nos. 3-9, Section A; vol. xxvi., No. 10, Section B; vol. xxvii., Nos. 1, 2, Section B; vol. xxvii., Nos. 1-5, Section C, and Appendix. Abstract of Minutes, Session 1907-8. List of Members, 1908.

Edinburgh—Royal Physical Society, Proceedings, vol. xvii., pp. 121-198.
——————— Royal Society of Edinburgh, Proceedings, vol. xxvii., pp. 161-432. Vol. xxviii., Nos. 1-6., pp. 1-512.
——————— Geological Society, Transactions, vol. ix., parts 1, 2.
Glasgow—Geological Society, Transactions, vols. x.-xii.

FRANCE.

Caen—Société Linnéenne de Normandie, Bulletin, Series 5, vol. x., 1906.
Nantes—Société des Sciences Naturelles de l'Ouest de la France, Bulletin, tome vi., No. 4; tome vii., Nos. 1, 2.
Paris—Société Entomologique de France, Bulletin, 1907, Nos. 13-21; 1908, Nos. 1-12. Annales, 1907, vol. lxxvi., trim. 3, 4.
——— La Feuille des Jeunes Naturalistes, Nos. 444-454.
——— Revue des Etudes Ethnologiques et Sociologiques, No. 2, February, 1908.
——— Notes and Contributions à la Geologie Parisienne, Notes, No. 4; Contributions 1, 2.
——— Service Technique des Eaux et de l'Assainissement, Derivation des Sources du Loing et du Lunain, November, 1906.
Lyons—Association Française pour l'Avancement des Sciences, Extrait 1906.
Rennes—L'Université de Rennes, Travaux Scientifiques, 1906, tome vi., parts 1, 2.
Tours—Société de Géographie, Revue, 1907, No. 1, trim. 1; Annale 24.

ITALY.

Florence—Società Entomologica Italiana, Bulletino 38; trim. 3-4.
Milan—Società Italiana di Explorarioni Geografiche e Commerciali, Anno 22, fasc. 22; Anno 22, fasc. 1-11.
——— Società Italiana di Sienza Naturali e del Musco Civico de Storia Naturale, vol. xlvi., fasc. 2-4; fog. 6½, 7.
Pisa—Società Toscana di Scienza Naturali, Memorie, vol. xxiii. Processi Verbali, vol. xvi., Nos. 4, 5; vol. xvii., Nos. 1-4.
Portici—Laboratoria di Zoologia Generale e Agraria, Bollettino, 1907, vol. i.; 1908, vol. ii.

India.

Calcutta—Department of Agriculture in India, Memoirs, Botanical Series, vol. i., No. 6; vol. ii., Nos. 1-4. Chemical Series, vol. i., Nos. 5, 6. Entomological Series, vol. i., No. 6; vol. ii., Nos. 1-5.

——— Indian Museum, Annual Report, 1906-7. Natural History Section, Records, vol. i., parts 1-4. Memoirs, vol. i., parts 1, 2, Text and Plates. Plague of Rats in India. Investigator, An account of Littoral Holothurioidiæ.

——— Survey of India, A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet, parts 1-3.

——— Pag Sam Jon Zang. History of the Rise, Progress, and Downfall of Buddhism in India, by Sumpa Khan-Po. Yeçe Pal Jor, 1908.

Madras—Government Museum, Bulletin, vol. v., No. 3.

Japan.

Tokyo—Imperial University of Tokyo, College of Science, vol. xxi., Articles 7-12; vol. xxiii., Articles 1-9; vol. xxiv., vol. xxxv., Article 19.

——— Imperial Earthquake Investigation Committee, Bulletin, vol. ii., No. 1. Publications, Nos. 22A, 22C.

——— Asiatic Society of Japan, Transactions, vol. xxxv., parts 1, 2.

Mexico.

Mexico—Sociedad Cientifica, Memorias y Revista, tomo xxiv., Nos. 6-12; tomo xxv., Nos. 1, 2; tomo xxvi., Nos. 1-3.

——— Instituto Geologico de México, Boletin, No. 23, avec 43 Planches. Parergones, tomo ii., Nos. 1-3.

Norway and Sweden.

Bergen—Museums Aarbog, 1907, Hefte 3; 1908, Hefte 1. Aarsberetning, 1907.

Stockholm—Geologiska Föreningens Förhandlingar, Band xxix.

Stavanger—Museum, Aarshefte, 17de Aargang, 1906.

Trondhjem—Kongelige Norske Videnskabs Selskabs Skrifter, 1906, 1907.

Upsala—Kungl. Vetenskaps Societeten i Upsala, Bibliographia Linnæana, Part 1, Liv. i.

Upsala—Entomologisk Tidskrift Journal, Aargang 28, Haft 1-4.

——— Nova Acta Regiæ Societatis Scientiarum Upsaliensis, Serei iv., vol. i., fasc. ii.

RUSSIA.

Dorpat—Bulletin Biologique, deux année, No. 1.

St. Petersburg—Academie Impériale de Sciences de St. Petersbourg, Bulletin, 1907, Series 6, Nos. 12-18; 1908, Series 6, Nos. 1-5, 8-11; 1906, Series 5, tome xxiv., Nos. 4, 5. Mémoires, vol. vii., No. 8; vol. viii., Nos. 1-6.

——————— Comité Geologique, Bulletins, 1905, vol. xxiv., Nos. 1-10; 1906, vol. xxv., Nos. Nos. 1-10; 1907, vol. xxvi., Nos. 5-7; 1908, vol. xxvii., No. 1. Mémoires, New Series, liv. 16, 21, 23-27, 29, 31, 33; 1907, liv. 22, Planches et Cartes, liv. 34, 35; 1908, liv. 32.

——————— Russischen Kaiserlichen Mineralogischen Gesellschaft zu St. Petersbourg, Verhandlungen der, Band. xliv., Lief. 2, Series 2.

——————— L'Institut des Mines de l'Imperatrice Catherine II. à St. Petersbourg, Annales, vol. i., No. 1.

——————— Musée Geologique Pierre le Grand, Travaux, vol. i., liv. 1-5.

Kiev—Société des Naturalistes, Mémoires, tome xx., liv. 3.

Moscow—Société Impériale des Naturalistes, Bulletin, 1906, Nos. 3, 4. Mémoires, tome xvii., liv. 1.

SWITZERLAND.

Geneva—Société Physique et de Histoire Naturelle, 1907, vol. xxiv.

Lausanne—Société Vaudoise des Sciences Naturelles, Bulletin, vol. xliii., Nos. 159-161; vol. xliv., No. 162.

Neuchatel—Société Neuchateloise des Sciences Naturelles, Bulletin, tome xxxiii., Année 1904-5; tome xxxiv., Année 1906-7.

Zürich—Annotationes Concilii Bibliographici, vol. iii., Anno 1907.

SOUTH AMERICA.

Lima—Cuerpo de Ingenieros de Minas de Peru, Boletin, Nos. 47-56.

——— Sociedad Geografica di Lima, Boletin, Ano 16, tomo xix., trim. 1.

Monte Video—Museo National, Anales, vol. vi., tomo 3, entrega 2.

Rio de Janiero—Observario, Boletin Mensal, July, 1906-June, 1907. Annuario 1907, An. 23.

San Paulo—Revista da Sociedade Scientifica de Sao Paulo, 1907, vol. ii., Nos. 5-8.

Brazil—Bibliotheca, The Brazil of To-day, by Arthur Dias.

SOUTH AFRICA.

Albany—Museum, Records, vol. ii., part 2.

Cape Town—South African Museum, Annals, vol. iv., part 8; vol. v., part 5; vol. vi., part 1; vol. vi., part 1. Report, 1907.

——————— South African Association for the Advancement of Science, Report, 1907.

——————— South African Philosophical Society, Transactions, vol. xviii., parts 1-3.

SANDWICH ISLANDS.

Honolulu—Bernice Panahi Bishop Museum, Occasional Papers, vol. iii., No. 2.

EGYPT.

Cairo—Société Entomologique d'Egypte, Bulletin, 1st year, 1908, January-March.

UNITED STATES OF AMERICA.

Baltimore—The Johns Hopkins University, Maryland, Geological Survey, Pliocene and Pleistocene, 1906. Physical Features, St. Mary's County, and Atlas; Calvert County and Atlas, 1907. Circulars, 1906, No. 10; 1907, Nos. 1-9; 1908, No. 1. Studies, Historical and Political Science, Series 14, Nos. 11, 12; Series 15, Nos. 1-12.

——————— American Chemical Journal, vol. xxxvii., Nos. 2-6; vol. xxxviii., Nos. 1-6; vol. xxxix., Nos. 1, 2.

Boston—Society of Natural History, Proceedings, vol. xxxiii., Nos. 3-9, pp. 43-485, Plates 12-38. Table of Contents of vol. xxxiii.

Boston—American Academy of Arts and Sciences, Proceedings, vol. xlii., Nos. 19-29; vol. xliii., Nos. 1-16.

——— California Academy of Sciences, Proceedings, Zoology, 4th Series, vol. i., Nos. 1-6.

——— University of California, Publications, Archæology and Ethnology, vol. iv., Nos. 3-4; Index to vol. iv.; vol. v., No. 1; vol. ii., No. 5; vol. vi., Nos. 1-3; vol. vii., No. 2; vol. viii., Nos. 1-3. College of Agriculture, Bulletins, Nos. 179-182. Zoology, vol. iii., Nos. 5-10, pp. 53-340, plates 9-23; vol. iv., Nos. 3-7, pp. 87-393; plates 4-24. Botany, vol. ii., Nos. 12, 13, 16, pp. 237-308; 319-354; plates 21-29; vol. iii., Nos. 1, 3, 4; pp. 1-302, 331-340. Entomology, vol. i., Nos. 1, 2, pp. 1-198. List of Titles, 3rd Series, vol. i., No. 1.

Cambridge—Museum of Comparative Zoology, Harvard College, Report, 1906-7. Bulletin, vol. xlviii., No. 4; vol. xlix., Nos. 5, 6; vol. li., Nos. 5-12; vol. lii., Nos. 2, 3.

———— Harvard University Museum, Louis Agassiz, by Professor William James, December 30, 1896. An address at the Opening of the Geological Section of the Harvard University Museum, by Alexander Agassiz, LL.D., June 12, 1902.

Chicago—Field Columbian Museum, Report, vol. iii., No. 1, Title-page of vol. ii. Publications: Ornithological Series, No. 125, vol. i., No. 3; Zoological Series, vol. vii., Nos. 4, 5; vol. viii., Nos. 115, 121-124; Botanical Series, vol. ii., Nos. 4-6, 124-126; Geological Series, vol. ii., No. 10; vol. iii., Nos. 5, 6.

———— Academy of Sciences, Bulletin, No. 4, plate 2; vol. vi.

———— The Pacific Scientific Institution, Publications, Special Series, No. 2.

———— Augustana Library Publications, No. 6.

Indiana—Academy of Science, Proceedings, 1906.

Kansas—University, Bulletin, vol. iv., Nos. 1-6.

——— Academy of Science, Transactions, vol. xx., part 2; vol. xxi., part 1.

Michigan—Academy of Science, Report, 9th, 1907.

———— Reprints from Science, N.S.; Nos. 688, 689.

Missouri—Botanical Gardens, Annual Reports, Nos. 11-18, 1900-1907.

St. Louis—Academy of Science, Transactions, vol. xv., No. 5; vol. xvi., Nos. 1, 2, 4-7.
New York—Public Library Bulletin, vol. xi., Nos. 8-12; vol. xii., Nos. 1-7.
———— Studies from the Rockefeller Institute for Medical Research, vol. vi., 1907; vol. vii., 1907.
———— American Museum of Natural History, Bulletin, 1906, vol. xxii.; 1907, vol. xviii., part 4; vol. xvii., part 5; vol. xv., part 2; vol. xxiii. Memoirs, Whole Series, vol. xi., part 2; vol. iii., part 4; vol. iv.; vol. ix., part 4; vol. xiv., part 2, 1905-8. Guide Leaflets, 1907, No. 26; 1908, No. 28. Annual Report of the President, 1906. Memoirs, Anthropology, vol. i., parts 1-3.
———— Academy of Sciences, Annals, vol. xvii., parts 2, 3; vol. xviii., part 1.
———— The Museum of the Brooklyn Institute of Arts and Sciences, Bulletin, vol. i., Nos. 10-13.
———— American Museum Journal, vol. vii., Nos. 6-8; vol. viii., Nos. 1-5.
Ohio—Scientific Laboratories, Denison University, vol. xiii., Articles 1, 4-6.
—— Laboratory Bulletin, Oberlin College, No. 13.
—— Wilson Bulletin, Oberlin College Library, Nos. 59-61, 1907.
Philadelphia—Zoological Society, Annual Report of Board of Directors, 36th.
———— Academy of Natural Sciences, Proceedings, vol. lviii., part 3; vol. lix., parts 1-3.
———— American Philosophical Society, Proceedings, vol. xlv., No. 184; vol. xlvi., Nos. 185-187. Transactions, vol. xxi., parts 4, 5.
Washington—Smithsonian Institution, U.S. National Museum, Bulletin, No. 50, part 4; No. 53, part 2; Nos. 57-60. Proceedings, vol. xxxii. Contributions, vol. x., parts 5-7. Annual Report, 1907; Annual Report of Board of Regents, 1906. Bureau of American Ethnology, Bulletin, No. 30, part 1. Annual Report, 25th. Bulletin of the University of Texas, No. 88, Catalogue, 1906-7.
———— United States Geological Survey, Monographs, vol. l. Professional Papers, No. 57, B113, D34; No. 53, B91, O57. Mineral Resources, 1905, 1906.

Washington—Department of the Interior, Annual Report, No. 28.

——————— Bulletin, Nos. 279, 286, 287-294, 296, 297, 300, 303-321, 323-327, 330, 331, 333, 334, 336, 339.

——————— Water Supply and Irrigation Papers, Nos. 182, 183, 187-217.

——————— Topographic Maps, Atlas Sheets, Nos. 86, 56, 65.

——————— United States Department of Agriculture, Yearbook, 1906. Reprint from Yearbook of 1906. North American Fauna, No. 26, Bulletin, No. 32.

——————— Academy of Sciences, Proceedings, vol. ix., pp. 275-558; vol. x., pp. 1-160.

Trenton—New Jersey, Archæologia, Nova Cæsara, by C. C. Abbott, M.D., No. 2.

Philippine Islands—Division of Science, Bureau of Mines, The Mineral Resources of the Philippine Islands, 1908.

LIST OF FELLOWS, MEMBERS,

ETC.,

OCTOBER, 1908.

Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in the address should be notified to the Secretary.

Date of Election.

Honorary Fellows.

1893. *Cossman, M., Rue de Maubeuge, 95, Paris.
1897. *David, T. W. Edgeworth, B.A., F.R.S., F.G.S., Prof. Geol., Sydney University.
1876. Ellery, R. L. J., F.R.S., F.R.A.S., Gov. Astron., the Observatory, Melbourne, Victoria.
1890. *Etheridge, Robert, Director of the Australian Museum of New South Wales, Sydney.
1905. Gill, Thomas, I.S.O., Under-Treasurer, Adelaide.
1905. *Hedley, Chas. H., Naturalist, Australian Museum, Sydney.
1892. *Maiden, J. H., F.L.S., F.C.S., Director Botanic Gardens, Sydney, New South Wales.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Prof. of Anatomy, Sydney University.

Corresponding Members.

1881. Bailey, F. M., F.L.S., Colonial Botanist, Brisbane, Queensland.
1907. *Basedow, Herbert, Breslau University, Germany. (Fellow from 1901.)
1880. *Foelsche, Paul, Inspector of Police, Palmerston, N.T.
1893. Stretton, W. G., Palmerston, N.T.
1905. Thomson, G. M., F.L.S., F.C.S., Dunedin, New Zealand.
1908. *Woolnough, Walter George, D.Sc., F.G.S., Lecturer on Geology in the University of Sydney. (Fellow from 1902.)

Fellows.

1895. *Ashby, Edwin, Royal Exchange, Adelaide.
1902. *Baker, W. H., F.L.S., Glen Osmond Road, Parkside.
1908. Benson, W. Noel, B.Sc., University of Adelaide.
1907. Black, J. McConnell, Alfred Street, Norwood.
1887. *Blackburn, Rev. Thomas, B.A., Woodville.
1886. *Bragg, W. H., M.A., F.R.S., Prof. of Mathematics and Physics, University of Adelaide.
1883. Brown, H. Y. L., F.G.S., Gov. Geologist, Adelaide.
1893. Brummitt, Robert, M.R.C.S., Gilberton.
1904. Brunkskill, George, Semaphore, S.A.
1906. Bundey, Miss Ellen Milne, 148, Molesworth Street, North Adelaide.

1907. *Chapman, R. W., M.A., B.C.E., Prof. of Engineering, University, Adelaide.
1904. Christie, William, Adelaide.
1879. *Cleland, W. L., M.B., Ch.M., J.P., Colonial Surgeon, Resident Medical Officer Parkside Lunatic Asylum, Lecturer in Materia Medica, University of Adelaide.
1895. Cleland, John B., M.D., Perth, Western Australia.
1907. *Cooke, T. W., D.Sc., Lecturer, University, Adelaide.
1907. Darling, John, Kent Terrace, Norwood.
1887. *Dixon, Samuel, Bath Street, New Glenelg.
1902. Edquist, A. G., Hindmarsh.
1904. Gordon, David, Gawler Place, Adelaide.
1880. *Goyder, George, A.M., F.C.S., Analyst and Assayer, Adelaide.
1896. Greenway, Thos. J., Adelaide.
1904. Griffith, H., Hurtle Square, Adelaide.
1896. Hawker, E. W., F.C.S., Adelaide.
1899. *Higgin, A. J., F.I.C., Assistant Lecturer on Chemistry, School of Mines, Adelaide.
1891. *Holtze, Maurice, F.L.S., Director Botanic Gardens, Adelaide.
1883. *Howchin, Walter, F.G.S., Lecturer on Geology and Palæontology, University, Adelaide.
1902. Iliffe, Jas. Drinkwater, B.Sc., Prince Alfred College, Kent Town.
1893. James, Thomas, M.R.C.S., Moonta.
1897. *Lea, A. M., Gov. Entomologist, Hobart, Tasmania.
1884. Lendon, A. A., M.D. (Lond.), M.R.C.S., Lecturer on Forensic Medicine and on Chemical Medicine, University, Adelaide, and Hon. Physician, Children's Hospital, North Adelaide.
1856. Lloyd, J. S., Alma Chambers, Adelaide.
1888. *Lower, Oswald B., F.E.S. (Lond.), Broken Hill, New South Wales.
1908. *Madsen, J. P. V., D.Sc., B.A., Lecturer, University of Adelaide.
1905. *Mawson, Douglas, B.Sc., B.E., Lecturer on Mineralogy and Petrology, University, Adelaide.
1874. Mayo, Geo. G., C.E., Hon. Secretary, 116, Franklin St., Adelaide.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., Angas Street, Adelaide.
1907. Muecke, Hugo, C.E., Grenfell Street, Adelaide.
1884. Munton, H. S., North Terrace, Adelaide.
1886. Poole, W. B., Savings Bank, Adelaide.
1908. Pope, William, Solicitor, Adelaide.
1907. Pulleine, R. H., M.B., C.M., Adelaide.
1907. Purdue, R. F., Mining Agent, Launceston, Tasmania.
1904. Reissmann, Charles, M.A., M.D. (Cantab), B.Sc. (Lond.), etc., Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc. (Lond.), F.C.S., Professor of Chemistry, University of Adelaide.
1905. *Rogers, R. S., M.A., M.D., Flinders Street, Adelaide.
1869. *Rutt, Walter, Chief Assistant Engineer, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1893. Simson, Augustus, Launceston, Tasmania.
1900. Smeaton, Stirling, B.A., C.E., Engineer-in-Chief's Office, Adelaide.

1871. Smith, Robert Barr, Adelaide.
1881. *Stirling, Edward C., C.M.G., M.A., M.D., F.R.S., F.R.C.S., Professor of Physiology, University of Adelaide, Director of S.A. Museum.
1906. Snow, F. H., Mutual Chambers, Adelaide.
1907. Sweetapple, H. A., M.D., Park Terrace, Parkside.
1904. Taylor, William, St. Andrews, North Adelaide.
1886. *Tepper, J. G. O., F.L.S., Entomologist, S.A. Museum. (Corresponding Member since 1878.)
1897. *Torr, W. G., LL.D., M.A., B.C.L., Brighton, South Australia.
1894. *Turner, A. Jefferis, M.D., Wickham Terrace, Brisbane, Queensland.
1902. Vandenbergh, W. J., F.R.S.L., F.R.S.E., F.R.M.S., J.P., Barrister and Solicitor, Pirie Street, Adelaide.
1889. Vardon, Joseph, J.P., Gresham Street, Adelaide.
1878. *Verco, Joseph C., M.D., F.R.C.S., Lecturer on the Principles and Practice of Medicine and Therapeutics, University of Adelaide.
1883. Wainwright, E. H., B.Sc. (Lond.), Wellington Road, Maylands.
1878. Ware, W.L., J.P., Adelaide.
1859. Way, Right Hon. Sir Samuel James, Bart., P.C., D.C.L., Chief Justice and Lieutenant-Governor of South Australia, Adelaide.
1907. Webb, Noel A., Barrister, Waymouth Street. Adelaide.
1904. Whitbread, Howard, Currie Street, Adelaide.
1886. *Zietz, A. H. C., F.L.S., C.M.Z.S., Assistant Director South Australian Museum, Adelaide.

Associate.

1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDICES.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

TWENTY-FIFTH ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED SEPTEMBER, 1908.

Your Committee reports with much gratification that this Section of the Royal Society has completed twenty-five years of its existence. When the Section had attained its majority a celebration was held to commemorate the event, and a résumé of its history was given by Mr. W. H. Selway, who had held the office of Secretary for nearly the whole of the time. Now that the Section has attained to a quarter of a century of years a period has been reached which deserves special mention as a record, not merely in matter of time, but also because during the past four years the membership has increased to nearly double the active field workers. Also, during that time some of the members have distinguished themselves by special work in scientific circles, and their association with the Section has added much to its prestige. All branches of natural history have their devotees, and while the departments of geology, entomology, and ornithology have workers, the popular branch of botany still claims the largest number of supporters.

EVENING MEETINGS.

At the evening meetings, which have been well attended, notes of travel have been given by members who had the opportunity during the year of visiting New South Wales, Victoria, Queensland, and Western Australia, while extended tours have been taken in our own State covering portions of the Barossa Ranges, the Murray Flats, Mount Lofty Ranges, and other places of local interest.

Special subjects have been dealt with by Mr. Stirling Smeaton, B.A., on "Mutual Aid in the Animal Kingdom," by Dr. Angas Johnson on "Microbes," by Mr. J. M. Black

on "Noxious Weeds and other Introduced Plants," and by Mr. R. E. Stanley on the "Basic Principles of Rock Classification."

At these meetings Exhibits of special interest in the various branches of science have been submitted.

Excursions.

Thirteen excursions have been held during the year, and as these were limited to Saturday afternoons the time at the disposal of members restricted the area of operations to within a few miles of the city. Much of the ground is revisited, and the spread of settlement is gradually adding to the difficulty of finding fresh fields for investigation within easy distance of the city.

The first excursion for the year was to Gaudy's Gully, on October 12. The gully is situated above Burnside, towards Magill, and being unfrequented offers many advantages to collectors.

On October 26 the National Park, at Belair, was visited. While it is gratifying to know that a small portion of the Park has been set aside and fenced as a special reserve for native flora, it is still hoped that the Park Commissioners will arrange to have a larger portion of the unfrequented parts fenced in so as to be free from molestation.

On November 9, 10, and 11, a party visited the neighbourhood of Kangarilla and Dashwood's Gully, but no official report was made or published of the excursion.

On November 30 Bridgewater was visited and Cox Creek traversed for some distance; the country in this vicinity is amongst the most picturesque in our hills.

On December 14 a drive was undertaken to Norton Summit, *via* the Green Hill Road and Summertown. At various points the excursionists alighted from the drag and revelled in the luxuriant profusion of native flowers. This was the last of the field excursions during the early summer months.

On February 15 the members were asked to make a marine excursion for dredging in the shallow waters of the Port Adelaide river. This was the most popular fixture of the year. The dredgings proved interesting and instructive.

The usual Easter excursion was arranged to include a visit to Yankalilla, but the means of travel to such a long distance presented difficulties, and the official excursion was abandoned.

During the winter months excursions were made to Blackwood on May 20, Largs Bay on May 30, National Park on June 20, and Brighton on July 18.

August 15 was the first of the early Spring engagements. Stonyfell was visited, and some of the earliest flowering plants and shrubs showed signs of the approaching warmer weather.

September 1 was the date fixed for visiting Golden Grove. The rain, however, was so persistent that the journey had to be postponed to the 12th. The beautiful display of wattle blossom showed how appropriate the name "Golden Grove" was to this locality, and the new camping-place was voted a great success. This locality will probably receive further attention.

There has been a marked improvement in the attendance at the excursions, and it is known that specialists have been successful in securing a number of rare species and some new records.

The membership has increased by fourteen, and now stands at a total of 120.

Regret is felt at the death of Mr. T. D. Smeaton, who, while not a member of the Section, always took a keen interest in the work by supplying information to members individually from his vast store of natural history knowledge, and also by contributing many short papers by way of correspondence. A vote of sympathy with Mr. Stirling Smeaton, B.A., in his long-continued illness was passed, and the hope expressed that he would soon recover to renew his work for the Section.

In addition to the work of the Fauna and Flora Committee in its efforts to secure a portion of Kangaroo Island as a reserve, Dr. R. S. Rogers, M.A., Mr. E. Ashby, Miss Archer, and the Hon. Secretary compiled an illustrated article, based on photographs taken by Miss Archer (during a bicycle trip taken alone across the island), and a map showing the proposed reserve, which were published in the Adelaide *Observer*. Copies of the paper were distributed amongst scientific and influential people and officials and Ministers in the States, to scientific societies in the Commonwealth and in England, France, Germany, and America. Gratifying acknowledgments were received of this action, but much remains to be done to secure this country in the interests of science.

Monthly Meetings.

October 15, 1907.—Lecture, Mr. S. Smeaton, B.A., "Mutual Aid in the Animal Kingdom."

December 3.—Notes of Travel—Mr. W. H. Selway, "On the Blue Mountains, N.S.W."; Mr. J. W. Mellor, "Queensland": Mr. M. S. Clark, "Western Australia."

May 19, 1908.—"Microbes," Dr. E. Angas Johnson.

June 16.—Papers on Easter Tours, by Mr. J. G. O. Tepper, F.L.S.; "Barossa," Mr. J. W. Mellor; "Murray Bridge," Messrs. H. H. D. Griffith and W. H. Selway.

July 21—Paper, Mr. J. McC. Black, "Some Noxious and Other Introduced Plants."

August 18.—Mr. R. E. Stanley, "Basic Principles of Rock Classification."

Excursions.

October 12, 1907, Gaudy's Gully; October 26, National Park, Belair; November 9, 10, and 11, Kangarilla; November 30, Bridgewater; December 14, Summertown; February 15, 1908, Outer Harbour; April 16, Easter Excursion to Mount Lofty; May 16, Blackwood; May 30, Largs Bay; June 20, National Park, Belair; July 18, Brighton; August 15, Stonyfell; September 12, Golden Grove.

J. McC. Black, Chairman.

E. H. Lock, Hon. Secretary.

September 22, 1908.

TWENTIETH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE OF THE FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA FOR THE YEAR ENDED SEPTEMBER, 1908.

The Kangaroo Island Reserve.

In the *Gazette* of December 26, 1907, was published a proclamation setting apart the Cape Borda Lighthouse Reserve of about 67 square miles for lighthouse purposes, and also for the purpose of the protection and preservation of the fauna and flora.

On January 11, 1908, several gentlemen waited upon the Commissioner of Crown Lands, urging that the area should be extended to the 300 miles originally asked for, subject to the existing leases. The Commissioner, in a reply dated February 5, stated that the area promised was considered sufficient for the purposes advocated. In March, and again in April, Mr. Ashby wrote at great length to the Acting Premier, setting out the reasons for the granting of the extended area, referring to the much larger areas that had been set apart in the other States, in New Zealand, and in America, and asking whether it was the intention of the

Government to vest the promised Reserve in Trustees. Replies were received to the effect that the area could not be increased, that the vesting of the Reserve in the Marine Board was a temporary arrangement, and that later on consideration would be given to the matter of vesting the land in a more suitable body. There has been a tacit understanding that the whole question would be re-opened after the return of the Premier from England.

The alarming increase of foxes all over Australia renders more urgent than before the necessity for granting the larger area asked for, as it is quite clear that within a very few years the ground birds will be extinct if their enemies continue to increase as they have done in the past few years.

The Committee is much disappointed in being still unable to report the fulfilment of the promises made by the Government two years ago, but hopes that something may shortly be done.

The Protection of Kangaroos.

In September last a letter was written to the Commissioner of Crown Lands recommending that the following areas should be proclaimed a Kangaroo District, namely, the counties of Adelaide, Light, and Hindmarsh, together with the western portion of the County of Sturt, comprising the Hundreds of North Rhine, South Rhine, Tungkillo, and Kanmantoo, and in November a reply was received that the request had been complied with, as evidenced by a proclamation in the *Gazette* of November 21, 1907.

The Birds Protection Act.

Emus and swans have recently been added to the schedule of birds to be protected during the whole year.

Samuel Dixon, Chairman.

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Statement of Receipts and Expenditure for the Year ended September 16, 1908.

Dr.	£	s.	d.
September, 1907—Credit Balance	3	1	6
Subscriptions for 1907-8	17	15	0
	0	5	0
September 16, 1908—Grant from the Royal Society	14	0	0
	£35	1	6

Cr.	£	s.	d.
Stamps	4	12	3
Printing	7	10	5
Plan of Kangaroo Island	0	5	0
Envelopes	0	4	0
Caretaker	1	5	0
Subscriptions paid to Royal Society	20	16	6
Balance	0	8	4
	£35	1	6

September 16, 1908—Balance in General Account	0	8	4
Balance in Excursion Account	2	19	1
	£3	7	5

We certify that the General Account, as above, is correct; Bank Passbook has not been produced.

J. S. Lloyd
Walter D. Reed } Auditors.

September 19, 1908.

S. Walters, Hon. Treasurer.

MALACOLOGICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1907-8.

There are twelve members on the roll of the Section, and ten meetings were held during the past year, at which the average attendance was five. The shells dealt with comprised the following genera:—*Nerita*, *Eulima*, *Rissoa*, *Scala*, *Natica*, *Cardita*, and *Carditella*. Two papers were contributed to the Transactions of the Royal Society by the Chairman of the Section (Dr. J. C. Verco, M.D., F.R.C.S., etc.), entitled "Notes on South Australian Marine Mollusca, with Descriptions of New Species," Nos. VIII. and IX.

BALANCE-SHEET, 1907-8.

Receipts.

	£	s.	d.
Grant from Royal Society	1	0	0
Subscriptions	2	7	6
Sale of Lists	0	1	3
Credit balance	0	6	2
	£3	14	11

Expenditure.

	£	s.	d.
Postages and Notice Cards	0	5	6
Subscriptions to Royal Society	2	7	6
Balance in hand	1	1	11
	£3	14	11

F. R. ZIETZ, Hon. Sec. and Treas.

September 15, 1908.

MICROSCOPICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1907-8.

OFFICERS.—Chairman, Mr. W. Fuller; Vice-Chairman, Mr. W. B. Poole; Hon. Secretary, Mr. H. A. Whitehill; Assistant Secretary, Mr. E. J. Bradley; Auditors, Messrs. T. Godlee and S. Smeaton, B.A.

Your Committee has to report that the conclusion of the Fifth Session of this Section since its reinstitution shows that satisfactory progress has been made. The attendance at the meetings has been good and the contributions of varied interest.

On September 24, 1907, the Section had the pleasure of inspecting the admirable rulings which have been recently produced by Mr. H. J. Grayson, of Melbourne, for micrometric and test purposes. A series of bands ruled from 1,000 to 120,000 lines to the inch was shown, which in point of quality and mounting represented the finest work hitherto accomplished in this direction.

On March 24, 1908, was exhibited a remarkable collection of new microscopes and apparatus recently acquired by members, no less than five complete instruments of value being shown. Veterinary Surgeon Desmond showed a superb Zeiss photomicrographic stand with all accessories and furnished with apochromatic lenses; Mr. A. W. Marshall, a new model "Edinburgh" microscope, by Watson, with Scöp mechanical stage and universal condenser; Mr. Roach, a Bansch & Comb instrument of excellent model; Mr. Baker, a Zeiss monocular erecting prism microscope; and Mr. H. W. H. Hale, a Zeiss III E stand with semi-apochromatic lenses of very fine order. Mr. Dollman also showed a new water immersion 1/10th, which he reported was of exceptional value in photography.

An important feature of the year's proceedings has been the inauguration of the Episcope and Projection apparatus recently acquired by the Royal Society and its affiliated Sections, the acquisition of which has given much satisfaction, and especially to the members of the Microscopical Section, with which, indeed, the idea of obtaining the instruments

originated. The success in obtaining these instruments is in the main the result of the incessant efforts of our chairman, Mr. W. Fuller, who, upon the suggestion that a projection lantern be obtained, drew attention to the new instruments of Zeiss, and who, together with Mr. E. J. Bradley, the secretary, formed a delegation to the other societies affiliated with the Public Libraries Board and sought their co-operation. Mr. Fuller is to be congratulated upon the successful issue of his efforts to further the interests of this Section and microscopy in general. Mr. Fuller also undertook the care of the instruments upon their arrival in Adelaide, and the task of erecting them.

During the year Rule 1 was altered to read "Joint Secretaries," in place of "Secretary."

The following meetings and excursions have been held during the session:—

September 24, 1907.—Annual general meeting. Exhibition of micrometric and test rulings by Mr. H. J. Grayson, of Melbourne, from 1,000 to 120,000 lines per inch, together with short address by Mr. Hale descriptive of their production.

October 22.—Paper by Mr. W. B. Poole, together with illustrative exhibits upon the life history of the curl-leaf parasite of the peach-tree. Demonstration of mounting simple objects by Mr. E. J. Bradley.

November 26.—Exhibition of polariscope attachment for microscope and choice mineral specimens, by Mr. W. Fuller. Liquid mounts of thirty years' standing, showed by Mr. Poole, who gave a short résumé of older methods of preparing and mounting.

February 15, 1908.—Dredging excursion.

March 24.—Mr. E. J. Bradley resigned assistant secretaryship owing to his continued absence from town, and a motion was passed recording appreciation of his valuable services to the Section. Exhibition of newly-acquired microscopes by members.

April 25.—Excursion to Semaphore.

April 28.—Exhibits of subjects of general interest and discussion.

May 26.—Exhibit of various specimens mounted by Mr. E. J. Bradley.

June 23.—Paper on "Odours in Potable Waters," by Mr. W. Fuller. Mr. H. W. H. Hale was appointed Joint Hon. Secretary.

July 28.—Paper by Mr. W. B. Poole upon "Julius Rheinberg's Multiple-colour Illumination Process, with

Various Preparations Demonstrated by this Method." Exhibit of light filters and monochromatic screens, with reference to their value in the improvement of the performance of microscopic lenses, by Mr. Hale.

August 25.—Demonstration of the recently arrived Episcope and Projection apparatus by the President of the Section, Mr. W. Fuller, who explained the optical principles involved in the construction and performance of these instruments and the method of operating, exhibiting a large number of microscopic and photomicrographic preparations, the work of members of the Section.

HAROLD W. H. HALE,
H. A. WHITEHILL, } Joint Hon. Secretaries.

MICROSCOPICAL SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

BALANCE-SHEET, SESSION 1907-8.

Receipts.

	£	s.	d.
Balance from 1906-7	3	19	0
Subscriptions, 1907-8	6	5	0
Grant from Royal Society	6	0	0
	£16	4	0

Expenditure.

	£	s.	d.
Printing and Postage	3	17	0
Advertising	0	8	6
Telegrams	0	3	3
Subscriptions paid to Royal Society	6	5	0
Balance in hand	5	10	3
	£16	4	0

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